Illuminating Engineer

XVIII. October, 1935 Price 9

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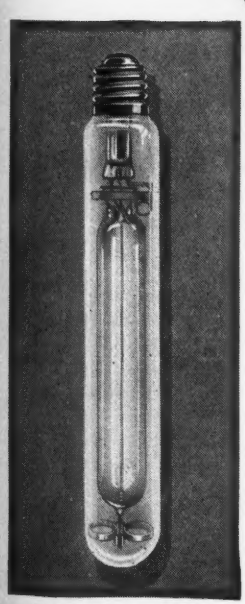

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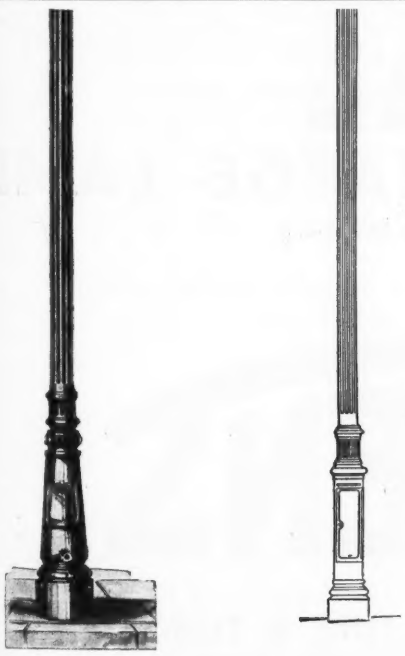

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Official Journal of
THE ILLUMINATING ENGINEERING SOCIETY
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The ILLUMINATING ENGINEER

THE JOURNAL OF GOOD LIGHTING

Edited by

J. STEWART DOW

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Principal Contents:

The Importance of Background

AT the recent Conference of the Association of Public Lighting Engineers several excellent papers analysed the nature of good Street Lighting.

An ideal system doubtless would approach daylight conditions. Objects would be rendered fully visible by light striking them from many different directions, so that not only their outlines but also their form could be seen.

This condition, however, is only occasionally and partially attainable. We must often fall back on the second alternative of rendering objects visible in outline or silhouette.

This is effected largely by securing a road surface of high and even brightness to serve as a background to moving figures and vehicles.

But—as films depicting series of views taken during motor runs showed—vertical backgrounds may be equally important. On winding roads of varying inclination whitened walls or judiciously placed light placards may be invaluable.

Authorities must plan not only for adequate lighting but for good visibility. Important thoroughfares should be surveyed from end to end and, where necessary, the light background required to enable public lamps to achieve their purpose should be provided.

Illuminating Engineering Society

Provisional Programme for Session 1935-36

In what follows we give particulars of the Provisional Programme of the Illuminating Engineering Society for the forthcoming Session. Except in the case of the Opening Meeting (October 8), meetings will commence at 7 p.m., and will be preceded by light refreshments at 6.30 p.m.

1935.

Oct. 8.—OPENING MEETING, when the arrangements will be as follows:—
4.30 p.m.—The EXHIBITS illustrating Progress in Illumination will be open for inspection.
5.30 p.m.—The PRESIDENTIAL ADDRESS will be delivered by Mr. A. W. Beuttell and the usual Report of Progress will be presented.
6.15 p.m.—Light refreshments.
6.45 p.m.—Demonstration of Exhibits.
(To be held at the E.L.M.A. Lighting Service Bureau, 2, Savoy-hill, London, W.C.2.)

Nov. 12.—A Paper will be read by Dr. R. J. Lythgoe dealing with VISUAL PERCEPTIONS UNDER MODERN CONDITIONS. (To be held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.)

Nov. 19.—INFORMAL MEETING: to be devoted to a discussion on the proposal "THAT THE USER IS THE ULTIMATE AUTHORITY ON ILLUMINATION."

Dec. 10.—A Paper will be read by Mr. L. J. Davies dealing with PRACTICAL ELECTRIC DISCHARGE LAMPS: THEIR GENERAL APPLICATIONS AND RECENT ADVANCES. (To be held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.)

1936.

Jan. 14.—A Discussion on APPLICATIONS OF ULTRA VIOLET LIGHT AND SOME ASPECTS OF FLUORESCENCE AND PHOSPHORESCENCE will be opened by Mr. F. E. Lamplough. (To be held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.)

Feb. 4.—The ANNUAL DINNER will take place at the Trocadero Restaurant, Piccadilly-circus, London, W.1 (7 for 7.30 p.m.).

Feb. 11.—Papers will be read dealing with CALCULATIONS OF LIGHT DISTRIBUTION by Mr. H. Buckley, and THERMAL TESTS FOR ILLUMINATING GLASSWARE by Mr. S. F. Dunkley and Mr. W. R. Stevens.

Feb. 25.—INFORMAL MEETING (subject to be announced later.)

Mar. 10. April 7. May 12.—For these two dates and for May 12, when the Annual General Meeting will take place, papers on Motor Car Headlights, Gas Lighting, and other topics have been suggested.

Supplementary meetings in provincial cities and visits to places of interest will also be arranged in the course of the Session.

Members have already been advised of the visit to the National Portrait Gallery and the National Gallery (Trafalgar Square, London) at 7 p.m. on October 22, when an opportunity of inspecting the new artificial lighting arrangements will be provided.

Public Lighting: Its Necessity and Administration

A paper on the above subject by Mr. E. C. Lennox (Vice President of the Association of Public Lighting Engineers) is to be read in connection with the Public Works, Roads and Transport Congress. The Session will commence at 11 a.m. on Tuesday, November 19.

A. Maurice Bell (Tottenham)
President of the Association of Public Lighting Engineers

The Photographic Representation of Street Lighting Problems

A paper on the above subject by Mr. R. J. Hopkinson is to be read at a joint meeting of the Illuminating Engineering Society and the Royal Photographic Society on the evening of Tuesday, December 17.

THE ASSOCIATION OF PUBLIC LIGHTING ENGINEERS

The Association is not, as a body, responsible for opinions expressed by individual authors or speakers.

Twelfth Annual Meeting and Conference Held in London, Sept. 9th—12th, 1935

—oOo—

THE Twelfth Annual Meeting and Conference of the Association of Public Lighting Engineers was held in London during September 9-12—the Association thus returning, after a decade, to the city in which its inaugural meeting was held. The gathering was, by general consent, a most successful one. There were over 600 names on the list of members, friends, and delegates—a number almost double that recorded in the previous year, and by far the greatest ever attained in the history of the Association. A new and much-appreciated departure was the arrangement whereby members of the Illuminating Engineering Society were invited to join in the Conference on payment of a nominal registration fee.

Another new departure was the holding of the Annual General Meeting on the opening day (September 9). This enabled the new President to be installed in office prior to the reception at the Hotel Metropole, where, supported by Sir Francis Goodenough and Mr. A. C. Cramb, he welcomed the guests.

The Conference was formally opened on the following morning by Viscount Elmley, M.P., Parliamentary Private Secretary to the Minister of Transport. After the new President, Mr. A. Maurice Bell, had delivered his address the usual pleasing ceremony, the presentation of certificate and badge to the retiring President (Mr. A. Forbes), took place. A paper entitled "Some Notes on Street Lighting Problems and on Directional Lighting by High- and Low-Pressure Lamps," was then presented by Mr. D. Chandler and Mr. A. J. Prestage (South Metropolitan Gas Company). Members and delegates were entertained to luncheon at the Hotel Victoria, at the invitation of the Gas and Electric Supply Industries, when the toast of the Association was proposed by Sir Henry P. Maybury.

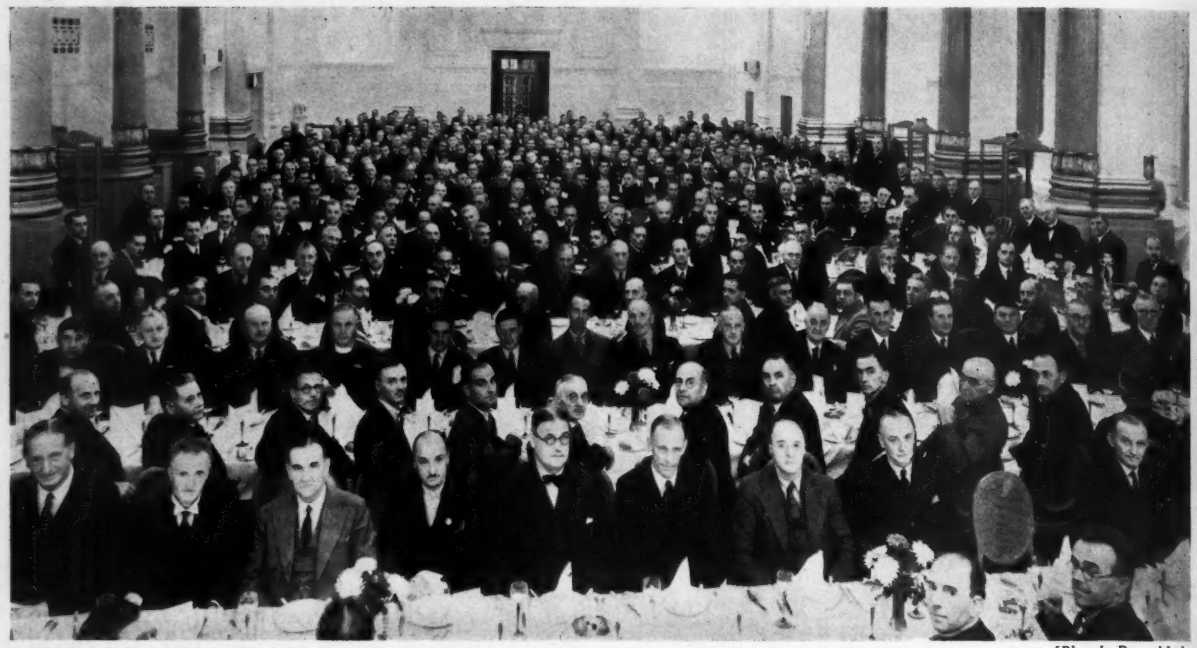
A paper, in the afternoon, by Mr. W. J. Allbright on "Developments in Electric Lighting in London," was followed in the evening by an inspection of the "Lights o' London," a most popular item, for which a series of seventeen loaded motor coaches was demanded.

On the following day papers on "Costs and Statistics of Street Lighting" (Mr. Ronald Parker, Sheffield Public Lighting Department), "An Analysis of Modern Views on Street Lighting and their Relation to Visibility" (Mr. F. C. Smith and Mr. F. K. Sawyer, Gas Light and Coke Company), and "Developments in Public Lighting in Berlin" (Dr. Ing. J. Adolph), were presented. In the course of the day visitors were entertained to luncheon, at the invitation of the Chairman and Directors of the Tottenham and District Gas Company, Mr. Henry Woodall presiding. The Association dinner and dance completed the day's programme.

On the final day (September 12) the morning was devoted to a paper on "The Importance of Kinematical Factors in Roadway Illumination," by Mr. R. Maxted, Mr. L. J. Davies, and Mr. G. S. Lucas (Research Laboratory, British Thomson-Houston Co., Ltd.). In the afternoon a visit by steamer to the Port of London had been arranged. During the Conference there were special events for ladies, including a tour of inspection of Selfridge's Stores, visits to the Kodak Works at Wealdstone, and Messrs. Lyons' Factories at Greenford, and a drive to Virginia Water. This opportunity should be taken to acknowledge the very generous hospitality shown to members and delegates—appreciation of which was expressed in an appropriate resolution at the Annual General Meeting (see p. 339)—and the great pains taken by Mr. A. Maurice Bell, the new President, in preparing for this important Conference. Others to whom thanks are due are Mr E. J. Stewart, the Hon. Editor, who once more prepared a most informative annual report; Mr. W. J. Jones and the E.L.M.A. Lighting Service Bureau for again supervising the lighting and electrical arrangements in the lecture theatre; and the General Electric Co., Ltd., who kindly placed their lantern and the services of their operator, Mr. Rickard, at the disposal of the Association for the period of the Conference.

Telegram received in response to the message conveying loyal greetings dispatched on the Opening Day of the Conference:—

"The King and Queen sincerely thank you for the message which you have conveyed from the Association of Public Lighting Engineers now assembled in Conference and much appreciate the good wishes to which it gives expression."



[Photo by Rawood Ltd.

A Photograph taken during the Luncheon in the Hotel Victoria on September 10th at the invitation of the Gas and Electric Supply Industries. The President (Mr. A. Maurice Bell) and Sir Henry Maybury, on his right, are seen standing.

Address delivered by Viscount Elmley, M.P.

(Parliamentary Private Secretary to the Minister of Transport)

at the Opening Meeting

I take it a great honour to have been asked to open this, the Twelfth Annual Conference of the Association of Public Lighting Engineers.

If I say that the great importance of the position that your members occupy in public life is enhanced by the perversity of your fellow men, it is not meant as any disparagement of that importance. I think that most of us are prepared to admit that the best hours of the day are those immediately following sunrise, but it is only those whose business compels them who are then abroad. A benevolent Government, recognising what is good for us, and to offset our own perversity to some extent, introduced summer time —thereby, as some aver, risking Divine disfavour—but even so, many of our waking hours are hours of darkness. We do not in this country turn night into day to the extent that they do abroad, and by midnight our towns are for the most part asleep, but it is in the evening that we seek our pleasures, and we rely on the adequate lighting of our cities to make these pleasures possible, or even, with the coming of flood-lighting, to provide them. There are still many houses throughout London that remind us by the torch extinguishers at their gates of the perils of travelling abroad at night when streets were not lighted, and the wealthy had to rely on the services of linkmen to protect them from footpads, and the poor, on the lanterns they carried themselves. We now accept street lighting in our great cities as a matter of course, and are more inclined to criticise its faults than value its very existence. Your President in his able address deals with the question of street lighting as affecting public safety on the roads—safety not from assault and highway robbery, but from a newer danger of motor vehicles. He refers to the Committee which was set up by the Minister of Transport last year, and I am glad to be able to tell you that this Committee has now prepared an interim report, which I hope will very soon be published. I cannot forecast what will be found in the report before it is published, but we may be sure that it will contain interesting and important recommendations. If the recommendations are to be carried out, we shall have to rely to a very large extent on the co-operation of the members of your Association, who have already afforded the most valuable assistance, by giving evidence before the Committee. I know that you will be prepared to give of your best in this important work.

The action taken by the Minister of Transport to reduce the number of accidents on the road has begun to show definite results. The weekly returns when compared with returns for the corresponding weeks last year, show substantial reductions in the numbers killed and injured, in spite of the fact that the number of motor vehicles on the road has greatly increased. But the Minister is by no means satisfied, nor, I am sure, are you satisfied, nor is the general public satisfied, that all has been done that can be done. I know it is not necessary for me to urge you to take all steps within your power to render our roads safer, for this is the manifest duty of every citizen, and, above all, of those who, like yourselves, are devoting their lives to the service of the community.

This Annual Conference provides an invaluable opportunity for the exchange of views and the pooling of knowledge and experience of every part of the country and of enterprise abroad. I hope that this year it will be even more successful than it has been in the past, and that your Association, carrying out its important work which so vitally affects the lives of us all, will go forward from strength to strength.

[Photo by Rawood Ltd.

A photograph taken during the Association Dinner and Dance which took place at the Hotel Victoria on the evening of September 11th. The President (Mr. A. Maurice Bell) is seen standing.

Presidential Address

by A. MAURICE BELL, Assoc. M. Inst. Gas E.

(Public Lighting Superintendent, Tottenham and District Gas Company)

(Delivered at the Twelfth Annual Meeting and Conference of the Association of Public Lighting Engineers, held in London during September 9th to 12th, 1935.)

Gentlemen,

In opening my address I wish to express my sincere appreciation of the signal honour which you have conferred upon me in electing me as President of this Association. I assure you that I am not unmindful of the responsibility involved in this task. In accepting that responsibility, however, I am fortified by the confident belief that, like my predecessors in office, I shall receive your co-operation and aid in furthering the interests of our Association and in increasing its usefulness—both to its own members and to the community whom we desire to serve and benefit.

It is fitting to recall that this, the Twelfth Annual Meeting and Conference of our Association, is the first to be held in London since the original meeting, which I attended and which I well remember. The founders of the Association may rightly feel some gratification and pride in the fact that it has made such substantial progress during so short a period of existence. During the last few years this progress has been specially marked, as is shown by the fact that the attendances at our Annual Conferences have increased year by year, and that, on the present occasion, our record of numbers has once more been surpassed. We have with us, as usual, leading Public Lighting Engineers and representatives of Local Authorities from all parts of the British Isles, and it is our special pleasure to welcome delegates and visitors from abroad—one of whom, Dr. Adolph, has accepted our invitation to present an account of the developments of Public Lighting in Germany. This is a happy choice at the present moment, when some of our members have only recently returned from the eminently successful meeting of the International Commission on Illumination in that country. It may be recalled that two years ago Monsieur Partridge contributed a similar account of Public Lighting in Paris. I trust that the practice thus initiated will be continued and that the Association, in years to come, will be informed in turn of the progress in Public Lighting in all parts of the world.

Other papers are to be presented dealing with technical aspects of Public Lighting. I feel, therefore, that I shall not be expected to enter too deeply into intricate technical points, and I shall, instead, try to fulfil the purpose of a Presidential Address by contributing a survey of some of the main topics that are in the minds of most of us to-day. It occurred to

me that it would be useful to touch on several of the chief changes and developments that have taken place since the formation of our Association.

Public Lighting and Road Safety.

Under modern conditions the material progress of a nation is measured largely by Speed, but Speed must be harnessed to Safety, and Public Lighting must be so developed as to become the handmaiden of the one and the agent of the other.

During the past decade one of the dominant factors —which has brought with it other changes profoundly influencing Public Lighting—has been the enormous development in the volume and speed of motor traffic. This development has not only led to an entirely new technique in the use of roads (so that to-day driving a vehicle on main thoroughfares tends to become more and more a mechanical process and the roadways themselves more and more resemble railways), but has unfortunately brought in its train a progressive increase in the number of road accidents, a fact familiar to everyone, though the seriousness of the position is perhaps not yet even fully understood. From data furnished by the National "Safety First" Association, it is evident that the number of accidents has increased almost continuously year by year, with the result that the annual figures (both for fatal and non-fatal accidents) have roughly doubled during the last ten years. During the year 1934, 7,343 persons were killed and 231,603 injured on the roads in Great Britain. It is small wonder that the Ministry of Transport is exploring every possible method of diminishing the annual death-roll.

In a very recent report on road accidents prepared by the police throughout the country for the Ministry of Transport, and which received considerable publicity in the Press, it is interesting to note that the worst period of the day for accidents is between 5 p.m. and 6 p.m., and the second worst period between 6 p.m. and 7 p.m. To us it is important to understand that the report was compiled from statistics covering the first few months of this year. The mean time for the lighting of street lamps during that period was 5.40 p.m. From these deductions the conclusion arrived at is, in fact, that the worst period falls between sunset and darkness, or during and just after the change-over from natural to artificial light before road users become accustomed to the altered conditions of visibility rendered by—shall I say—good, bad, or indifferent public lighting. This emphasises a problem upon which we must concentrate in an endeavour to solve what may be regarded as a definite daily period of danger.

We, as Public Lighting Engineers, are interested chiefly in the part that Public Lighting can play in increasing the utility of roads and enhancing their safety. If it be true, as a recent enquiry in the United States has suggested, that "the night-hazard is roughly four times the day-hazard," the need for good road lighting is surely evident. Analysis of statistics, such as those prepared by the National "Safety First" Association in 1933 and by the Ministry of Transport in the subsequent year, with a view to establishing the influence of lighting conditions, is itself something of a hazard! Much discretion is needed in the interpretation of these statistics. For example, whilst we all believe that, other things being equal, better lighting must lead to greater safety, it may well happen that it also enables motorists to proceed at greater speed or leads to an increase in the volume of traffic (cases have been mentioned in which better lighting of a new by-pass road has been installed with the deliberate intention of diverting traffic and has achieved this end). A road may be so badly lighted as to be shunned by traffic. It might thus be relatively free from accidents, though of little service to the community. The first object of street lighting is to render motor traffic safe by removing as far as is possible the principal cause of accidents—inability to see clearly at night—because one fact that does seem to emerge from the investigation of statistics is that the proportion of accidents occurring at night has tended to increase year by year. This, of course, does not mean that Public Lighting has deteriorated, but that the volume of night motor traffic has risen enormously. The inference is that good artificial lighting on the roads is even more important than in the past.

Higher Values of Illumination Justified.

At this stage I would like to quote an effective comparison that has occasionally been used to illustrate the need for better Public Lighting. So far back as 1922 the Home Office Departmental Committee on Lighting in Factories and Workshops recommended five foot-candles as the minimum illumination desirable for fine work—a value which in the present day is often substantially exceeded. A street such that no part receives less than 0.05 foot-candles (Class "F" in the British Standard Specification) would, under present conditions, be considered relatively well lighted. Yet this value is only one hundredth of that named as the minimum for industrial lighting and is actually less than one ten thousandth of the average value furnished by daylight from an unobstructed white sky. In my opinion no street carrying any material volume of traffic should be lighted to a lesser intensity than that corresponding to Class "F." In view of the above comparison, and the evident speed and complexity of motions of modern traffic (certainly comparable with processes in some factories), it is difficult to understand how *any* installation of street lighting under present conditions—even one fulfilling the requirements of the highest class according to the specification—can be condemned as "extravagant," even if, for reasons of economy, it may be difficult to secure. Councillor Reid, of Aberdeen, welcoming the conference last year, summed up this side of the question in a "nutshell," when he said: "No matter how much we spend on street lighting, if it is going to save a life, it is worth it."

I do not, of course, wish to convey the impression that the provision of a certain minimum illumination is all that is necessary to ensure a well-lighted street. When one looks back on conditions prevailing when our Association came into existence, one realises how much research has since been done both in regard to the design of fittings and equipment and in the analysis of the factors which constitute good lighting. One point that is much better appreciated now is the distracting effect of glare from unduly brilliant or imperfectly arranged lights. Another is the changed view-point in regard to the desirability of extreme uniformity of illumination between post and post—a change occasioned mainly by recognition of the effect of the highly polished road-surfaces of dark texture with which we are now familiar.

Influence of Road Surface.

Whilst we are all agreed that a light-coloured road surface would be of a great advantage, if we could get it, there is some variety of opinion in regard to polish—which some consider a positive advantage. At the moment there would seem to be two schools of thought—that which holds to the ideal of general illumination of objects in the same manner as is effected by daylight, and that which pins its faith mainly to achieving even and high road brightness so that objects are revealed silhouetted against this brighter background. These views may find expression in some of the papers to be set before us.

One difficulty that has to be faced in studying the brightness of road-surfaces—and especially in any

effort to include this important factor within the scope of a specification—is the extraordinary difference in appearance of a road in a wet condition, as compared with its aspect when dry. A road which is quite satisfactorily illuminated on a dry night—such as is ordinarily selected by viewing committees—may appear very different after heavy rain, when unexpected regions of "blackness" may be revealed, as the point of view of the observer changes. In such circumstances it may well happen that an alteration in the position of one or two lamps may make all the difference between obscurity and comparative safety, especially where a bend in the road occurs. In this connection the impression caused by the lights themselves at distant bends in the road should be studied. Under some conditions they may easily mislead drivers in regard to the actual course of the road. Such points as these require detailed study by the Public Lighting Engineer.

Whilst appreciating that road surface brightness is a vital factor when the convenience of motor traffic is the main consideration I may also point out that on other types of roads, e.g., in the shopping centres of a city, or in purely residential areas with little traffic, different aspects may prevail. Therefore, in any general conclusions on street lighting conditions, I would like to see a combination of these two outlooks, rather than exclusive reliance on either.

Greater Uniformity Needed.

I have explained that modern views of public lighting on the whole tends to attach less importance to extreme uniformity of illumination from post to post—a condition which may in any case be nullified by the behaviour of the polished roadway, and by the variation in its behaviour when dry and wet. There is, however, another form of uniformity which we should certainly seek to secure—namely, the elimination of abrupt changes such as may occur in passing from one road to another, or even within a few miles on the same road, when this is lighted by different authorities. These extreme divergences arise not only from varying intensities in the lights themselves, but also from the variety of positions assigned to them, and other departures in method. Four years ago a London coroner observed "there are spots all over London where lighting conditions have not been adapted to the altered circumstances caused by the advent and rapid development of motor traffic." There is still ground for serious criticism. The variations I have referred to undoubtedly constitute a contributory cause of accidents. They could be eliminated to a great extent by the general application of the British Standard Specification and by systematic classification of roads in each area. The specification, now in course of revision, already forms a valuable basis of classification of roadways. Personally, I attach great importance to the "evening up" of illumination, so as to eliminate great contrasts or at least ensure that changes in brightness take place gradually. This is particularly important in passing from a side street to a main street. A driver, in such circumstances, is particularly apt to be distracted by sudden changes in brilliancy. Admittedly, however, the "grading" of illumination in such cases needs care; having consulted opticians and others, and received conflicting opinions, I have fallen back on practical tests, but cannot as yet suggest a definite formula. I do not consider that a very high degree of illumination on certain roadways is so valuable as even medium uniform illumination on others. When a certain roadway is very much more brightly lighted than adjacent ones, this seems to create a feeling of confidence and results in increased speed on the part of fast-moving vehicles; whereas a well-planned installation, giving medium and uniform road illumination tends to provide greater safety, because both drivers and pedestrians are more alert. This, at least, seems to me the wisest method until a much higher standard of illumination can be made general.

The Ministry of Transport Committee.

Such problems as these suffice to show that the committee appointed last year by the Ministry of Transport "to examine and report what steps could be taken for securing more efficient and uniform street lighting, with particular reference to the convenience and safety of traffic," has commenced its task at an opportune moment. Our Association was invited to give evidence before the committee, and was able to present some instructive data illustrating the extraordinary lack of uniformity that prevails in some areas at the present time. The appointment of this committee, to my mind, was a judicious step. Whilst awaiting its conclusions, we may regard its formation as a gratifying recognition of the national importance of public lighting, and its direct relation to the safety of the roads.

Undoubtedly, at the present moment there is an urgent need for improvement in road lighting. Looking back over the period of existence of our association, we cannot escape the conclusion that, despite much patient work by public lighting engineers, and notwithstanding certain outstanding improvements, the advance in this field has not been comparable with that in some other fields of lighting. The lighting of shops and stores, for example, where a direct appeal to business considerations is possible, has developed immensely. A new standard has been achieved—because of the recognition that better lighting brings an immediate return in the form of increased and more rapid sales. Suggestions for expenditure on better public lighting do not usually meet with the same ready response. An L.C.C. authority last year stated that "modern engineering leaves no excuse for bad lighting, and where bad lighting exists, it means there is a fault in the policy of the local authority." Bad public lighting—especially on a main thoroughfare—is a gamble with fate. Every motorist and pedestrian risks a danger. Good and efficient public lighting can be secured if ratepayers will foot the bill. But no money can buy back the lives of those killed, nor restore to health those maimed as a result of inadequate lighting. Records at coroners' inquests occasionally afford evidence of cases in which some defect in lighting has been blamed for a tragedy; I have already quoted remarks of one coroner on the subject, but who can say in how many other instances a failure in judgment or indecision on the part of a driver, due to inability to see clearly, or momentary dazzling by a glaring light, has contributed to an accident?

A Classification of Roadways.

What is mainly needed at the moment is a systematic study and classification of roadways, and their needs in regard to Public Lighting. Road conditions are changing rapidly and continuously. Vehicular traffic is multiplying in figures undreamed of a few years ago. Lighting units and installations should be planned to meet, not only present-day requirements, but also future eventualities. Most of us could mention instances of roadways, the functions of which have completely altered even during the past ten years. Certain routes which a few years ago were regarded as merely residential, have become important channels for outgoing and incoming traffic. Arterial roads, originally constructed to relieve congestion of traffic in built-up areas, have themselves become thickly populated and highly congested. In such cases road illumination which might have been considered ample a few years ago, has now become obviously inadequate. Arterial roads, too, as I have shown on other occasions, present a particularly difficult problem because they pass through the areas of many local authorities, each acting independently, and not infrequently reluctant to bear the cost of proper lighting of their section of roadway; some-

times they are quite unable to do so. Lack of funds is here a crucial difficulty.

Cost—A Suggested Solution.

In a paper given some time ago before a large body of municipal officers, I gave my solution. My ideas have not changed, and I repeat that the cost of public lighting, to a standard necessary to meet local requirements, should not fall solely on the local authority, but should be met out of a common fund for the purpose, to which local and county authorities should contribute, and which should be aided by a generous contribution from the Road Fund.

Lighting of roadways should be an integral part of their construction and maintenance. Of a total of 8,760 hours per annum during which roads can be used, the dark hours amount to over 4,000, approximately 46 per cent. Bearing in mind the heavy cost of construction of many such thoroughfares, it is merely judicious expenditure to equip them with lighting that will enable them to be used with safety by night, thus relieving in part the heavy congestion during the day. In the interest of safety, proper lighting should be made compulsory on all roads in and through towns, and on all main arterial roads carrying heavy traffic.

I have already indicated the importance of planning for the future. Public Lighting engineers regard as part of their normal duties the maintenance of existing installation, and their renovation from time to time by the substitution of more efficient lighting devices. Such "patching up" and many minor improvements by which the ratepayers benefit are often undertaken at little, if any, extra cost. A skilful Public Lighting engineer can save the authorities considerable sums in this way, and committees would do well to accept the assurance that retaining obsolete and inefficient fittings, when more up-to-date equipment can furnish more light at less cost, is false economy.

But, personally, I am opposed to the patching up of installations that are definitely out of date, not only in equipment but in design. In such cases the only real solution is redesign in accordance with modern methods. In this connection I may throw out the suggestion that agreement on certain principles that should be observed in all new installations might be expedient. In existing installations a compromise, if regrettable, may sometimes be inevitable. But in the case of a new installation let us at least proceed on lines that will ensure lighting, best suited to modern conditions, so far as it can be determined by present experience.

I am now drawing towards the close of my address. Enough has perhaps been said to indicate the complexity and highly technical nature of the subject of Public Lighting, to which additions are being made year by year. As an instance, I may mention the illumination of traffic signals and road signs which now frequently fall within our scope. I would like to emphasise most strongly the necessity of adequate illumination of such signs during the period of darkness. In the daytime it is possible for an alert driver, in nearly every case, to see cross-roads, sharp bends, narrow bridges, etc.; but at night, unless roads and signs are properly illuminated, there is the "shadow" of doubt, leaving a margin of error for the motorist or pedestrian to bridge in a split fraction of a second. Light plays an essential part in vision by night, and hence in the safety of the public. Those concerned with road safety precautions would, therefore, do well to take the Public Lighting engineer in their area into counsel — for assuredy through his duties he knows, or should know, every danger spot on his roads.

The Public Lighting Engineer.

May I also emphasise—what is a point of principle with our Association—the expediency, in towns and cities of any size, of employing a thoroughly qualified Public Lighting Engineer to handle the street lighting. Experience in some of our greatest cities has proved the wisdom of this step. Where the expenditure of public money on lighting is considerable, expert supervision is a whole-time job, and it is my conviction that there is quickly approaching a time when the fully trained Public Lighting Engineer will be in urgent demand to a continually increasing extent. This has been recognised by our Association, which has recently appointed a committee to map out the courses of study for those who wish to enter the profession. I hope that tentative suggestions on this point will be submitted to members during my term of office.

In this connection, I have been asked to say a few words in regard to the future of our Association which has reached such an interesting stage in its career. We are, of course, primarily a professional body. I hope that the number of fully qualified Public Lighting Engineers within our ranks will progressively increase, and that the profession of "Public Lighting Engineer" will, in time to come, be more and more firmly established and recognised. It should be the task of our Association to safeguard the status of the Public Lighting Engineer as a public servant undertaking duties of great importance to the community. In this connection many questions relating to the administration of Public Lighting, besides its technical aspects, come within our scope. Therefore, it will be understood that we must preserve our distinctive position, and that we could not, consistently with our aims and objects, merge completely with any other organisation.

But I am sure that we all recognise that Public Lighting, whilst primarily the care and concern of our members, is likewise of interest to other experts as well as to the community. We shall, therefore, gladly co-operate with other bodies in discussions on Public Lighting and put the special knowledge of our members at their disposal; and the more others will help us to kindle interest in Public Lighting and promote public appreciation of its supreme importance, the happier we shall be.

The Lighting of London.

Before closing, I would like to draw attention to the opportunity presented at this conference of studying the lighting of London, which offers many features of interest. Not only will you find here some of the finest examples of street lighting in the country, but you will find represented practically every form of lighting as well as warning devices of the most modern pattern. Incidentally the method of administration of the lighting, for which over thirty different authorities are responsible, is probably unique amongst great cities at the present time. I would strongly recommend every member present to make the tour of inspection of the "Lights o' London" by motor coach. The ground to be covered is considerable and has been so selected as to afford a general idea of the positions of the chief installations, so that any of special interest to individual members may be identified and noted by them for more thorough examination before leaving London.

Conclusion.

In conclusion, I should like to put on record my deep appreciation of the aid which the Chairman, Directors, and Chief Engineer of the Tottenham and District Gas Company have given me. and of the facilities they have placed at my disposal in connection with this conference.

I thank you all once more for the signal honour which you have conferred upon me, and which I will do my utmost to merit during my term of office.

Some Notes on Street Lighting Problems and on Directional Gas Lighting

by DEAN CHANDLER and A. J. PRESTAGE, B.Sc. *(South Metropolitan Gas Company)*

(Delivered at the Twelfth Annual Meeting and Conference of the Association of Public Lighting Engineers, held in London during September 9th to 12th, 1935.)

Our original intention was to devote this paper exclusively to the subject of directional lighting by gas lamps. It has, however, been indicated that an enlargement of its scope would not be unwelcome. We appreciate this indulgence, since what we propose to say on the subject of directional lighting by gas lamps is not a very long story. We have, therefore, taken this opportunity to comment on one or two matters on the art (or is it the science?) of street illumination, in the hope that a lively discussion may follow, which is, we suppose, one of the chief reasons for your meeting together.

Views of the Experts.

Let us consider quite briefly the present position with regard to street lighting.

This may be gauged to some extent by the recent statements of one or two recognised authorities. In a "Symposium on Illumination," Mr. C. C. Paterson has stated that "the lighting of our streets and highways is passing through a period of evolution, and the best informed are most reluctant to be dogmatic about the form which the most effective street lighting will ultimately take, but we are at least progressing somewhat towards understanding the right principles to follow."

Dr. Pirani (Berlin) recently commented that "only a few years ago it seemed to everybody that illuminating engineering had reached a degree of perfection which could hardly be surpassed. To-day we see that as well in the development of light sources as in the question of adaptations of illumination to different visual tasks we are in the middle of a tumultuous evolution."

"Finality is not reached, nor will it be reached for many years" is the opinion of Mr. Mastermann, who thinks that "so long as there is any uncertainty and confusion as to the objects of street lighting, so long will there be various schools of thought regarding the proper type of street lighting to be provided."

Mr. Langlands has suggested that "the scientists should reserve their theories on surface brightness and like postulations until they have means of assessing and measuring their values." Mr. Paterson, however, has replied that this is precisely what the theorists have now achieved; "there are now means of assessing and measuring their values."

We are credibly informed that on the Continent, so far as roads designed specially for fast traffic are concerned, the view is held by some authorities that the best thing to do is to provide only just sufficient light to indicate clearly the boundaries of the road in the direction of its width, the main area of the road being left in comparative darkness. This may be right for the motorist, but what of the pedestrian? In this connection Mr. Walter Garner's comment is interesting. His "experience as a motorist was that the safest road was one in which there was no lighting at all"!

Attention of late has been directed to the recently evolved theory that surface brightness is the all-important element to have in mind, but it would appear that at the recent International Commission on Illumination held in Berlin, this view was not shared by some of the delegates who took part in discussions on street lighting.

We have quoted these views in order to show that considerable divergence of opinion still exists among experts concerning the fundamentals of the street-lighting problem. If basic principles are still in the melting pot—and from the foregoing views one cannot escape that conclusion—then it is obvious the lighting engineer must rely mainly on his own experience and knowledge of the practice of the art of street lighting to get him over the stiles.

It is to the credit of public lighting engineers that, with few exceptions, the lighting of highways and roads of our cities and towns is so satisfactory, and that a relatively high standard of effectiveness and efficiency has been maintained. Street lighting engineers have, in short, proceeded with the task with commendable perseverance and persistence, while the experts have pursued their own course, and have continued their analysis of principles and theories.

The Point of View of the Citizen.

In this country there is a consensus of opinion in favour of illumination of the roads on a scale sufficiently generous to enable the man in the street to get about town in comfort and safety, and any system of lighting which does this will have the approval of the average citizen, who will judge the efficiency or inefficiency of the system by that standard alone. This has been cogently expressed in a paper on "Public Lighting by Electricity," in which the author said that "if a majority of citizens find that they can see properly with a given installation, then that installation is a good one, even though it may transgress many of the ordinarily accepted principles of the lighting expert; and, conversely, if a majority of the citizens find that they cannot see properly with a given installation, then that installation is a bad one. In other words, the public is the final court of appeal regarding the effectiveness of street lighting." Apropos of this, we may remark that on a recent occasion, when a party of lighting experts were viewing an installation of modern street lighting and expressing many and varied opinions concerning its character and quality, a few onlookers expressed their opinion that the illumination of the road was excellent, the visibility good, and the lighting left nothing to be desired. The doctors continued to differ, and no sort of agreement could be reached. The matter is still being hotly disputed. In the meanwhile, the revision of old street lighting installations has to proceed apace. Their substitution by more satisfactory systems cannot be delayed by differences in regard to the theory of street lighting.

It may be said that laymen are not competent judges of these matters. This is doubtless true, for they are scarcely in a position to analyse the effect of vision by direct illumination, by silhouette effect, and the criteria on which illuminating engineers rely may have little or no meaning for them. Can they, or can they not, see to get about in safety and comfort? That is the one consideration by which they are guided.

It is to be noted that modern street-lighting systems are nowadays often approved or rejected by their

visual effectiveness as judged by a committee of inspection for whom demonstration lighting is provided by street lighting contractors. Those who have been present on such occasions know that the lighting of the street is judged by what can be seen and the comfort of *seeing*.

It should be said in defence of the experts that they have certainly introduced a stream of new ideas into what might have become a stagnant condition of rule of thumb practice in the matter of street lighting. We are here prompted to remark that there is one aspect of the problem of lighting which, apparently, has somewhat escaped the attention of scientists, although it is, in fact, one with which they are especially fitted to deal.

Attention has been drawn to the fact that the effect of light falling on the central region of the retina is very different from that experienced when it falls on the outer portion of the retina. Has this any bearing on street lighting in its relation to public safety? Undoubtedly; for peripheral vision of things in motion or at rest is responsible for a very great part of what constitutes the fields of view of both driver and pedestrian in our streets to-day. It appears that this matter of peripheral vision has been somewhat overlooked; indeed, one school would have us believe that, as drivers, our view of a street is narrowly circumscribed and limited to foveal vision of stationary objects seen from a car at rest. There is no motion anywhere; pedestrians and driver alike are still in death even before the latter has commenced his work! What form of street lighting ensures the greatest degree of safety in a street peopled by living pedestrians, living drivers, living cats, dogs, etc. That is essentially the problem that awaits solution.

Logically, it would appear that the starting point of discussions on the problems of lighting in relation to road safety is a clear understanding and knowledge of the characteristics of the organ of vision. Is our knowledge concerning this adequate and reliable?

There is obviously a definite relationship between the physiological and psychological functions of seeing which must surely have an important bearing upon street lighting problems.

The physicist, for the most part, concentrates on the measurable factors of the problem and is seldom concerned with the subjective aspects of the matter. The correlation of visual sensations and the physical stimuli which produce them is of importance.

The illumination of a street is one part of the problem—the normal reactions and behaviour of individuals to the system of lighting are not less important.

We should like to advert to yet another matter which does not appear to have received full discussion, namely, the colour of light that should be regarded as ideal in streets. In this connection it is of interest to recall that Dr. Hugo Krüss, of Hamburg, in answer to a questionnaire on a Proposed Standard Specification for Street Lighting, stated that " as regards colour, an approximation to the quality of light yielded by a white cloudy sky should be aimed at."

The Practical Aspect.

Street lighting appliances are now available in such variety that it is possible for the experienced lighting engineer to plan and produce satisfactory street lighting schemes suitable for any out-door conditions provided no serious financial handicap is imposed; that is the real crux of the problem. The planning of a scheme of street lighting is in reality a straightforward matter, provided sufficient light is allowed and certain well established rules are followed. In the matter of planning, the street lighting engineer's task is not so onerous as might be imagined. The data now available in textbooks and the technical press, and the existence of a wide range of lamp and lamp-gear manufacturers' catalogues containing, in detail, information on all types of lighting equipment—total flux, character of the light distribution and the like—provide all the material needed in the planning of street lighting schemes. One other thing is, of course, necessary practical knowledge of the art of street lighting. If the problem seems to be difficult this probably arises from the fact that all manner of extraneous considerations are apt to be introduced causing it to appear involved, abstruse and complex. Mr. Paterson has said, " We should not be hypnotised by its complications."

It is probable there would be no problem of public lighting did not considerations of cost enter into the matter. It is to be regretted that reasonable expenditure of public money to provide adequate street illumination has been and, in certain quarters, is still, considered to be unnecessary extravagance. This, however, is no new phase of the matter. About half a century ago Mr. William Sugg in a paper on " Public Lighting " said that, " The public imperatively demanded improved street lighting, but the action of the local authorities in many places had been to decrease the light while the increase in night traffic had gone on from year to year."

It will not be inappropriate to emphasise the fact that the first essential requirement for satisfactory road illumination is the provision of *sufficient luminous flux per unit area of road*. Parsimony in this matter is false economy, and can only lead to disappointment in the matter of satisfactory street lighting.

Next in order of importance is the character of the curves of polar distribution of the light from the source, for it is this which will largely determine the character and quality of the lighting of the road. There are, of course, other factors which enter into the problem such as the height and distribution of the lamp-posts and their disposition along the road. But knowledge of the character of the polar distribution of the light from the source will enable all other particulars referring to the lighting system to be calculated. We may now summarise the essential requirements for planning a street lighting installation.

Essential Requirements.

1. A suitable light source of adequate total luminous flux for any given set of conditions;
2. A light source of low intrinsic brilliance;
3. The distribution of light from the source to be of a character which will give as far as possible uniform illumination between lamps. This, by some experts, is not considered a desideratum.
4. The complete light unit (lantern and light source) to be capable of easy maintenance;
5. Reflecting and refracting attachments to be fool-proof, and as far as possible resistant to unfavourable external conditions.

Directional Lighting.

But to turn to the more practical matters of directional lighting by gas lamps. By reflection, refraction, or diffusion, it is possible to control the direction of the light from any source. The so-called directional devices for street lamps which were introduced just after the war were, for the most part, simple in character. They consisted of pieces of polished metal bent to some suitable shape, or pieces of mirror glass set in a metal frame. These were attached to or placed in the lantern in such a way as to produce the appearance of a greater number of light sources in the lamp than was actually the case. It was a natural development to improve the reflectors by making their surfaces irregular in order to disperse the light to better effect. It is possible that the introduction and subsequent development of the many forms of mirror reflectors which have

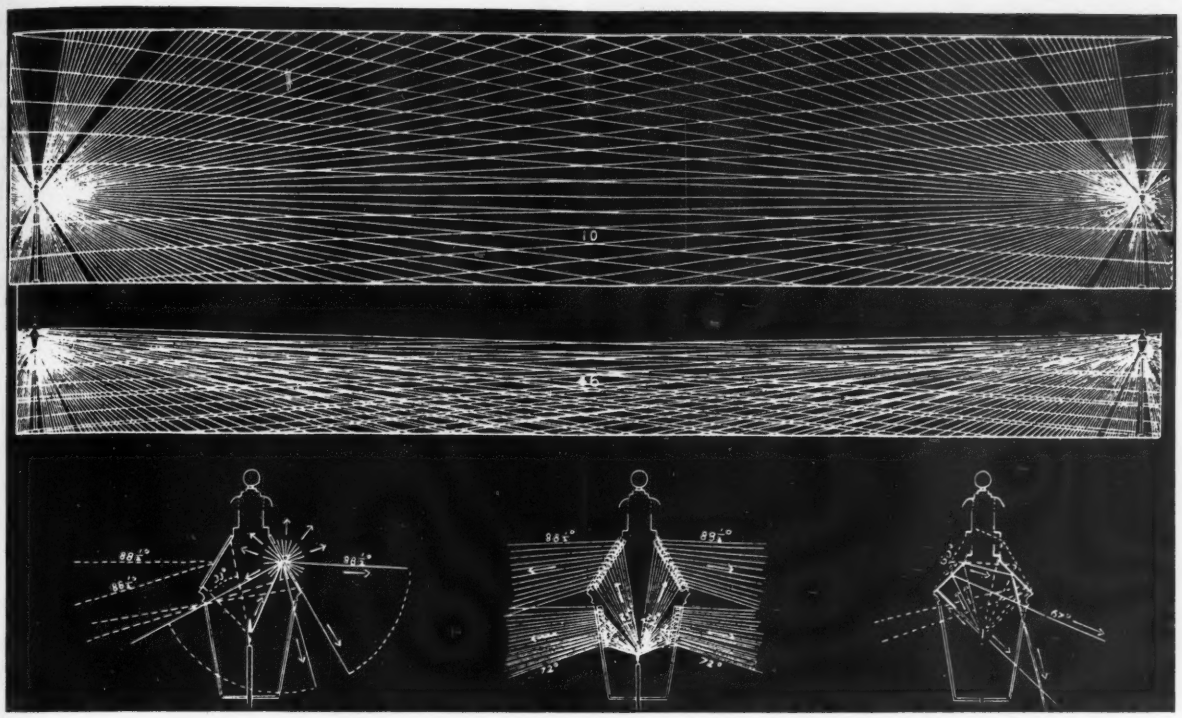


Fig. 1. Original Diagram of Skelton's Catoptric Lamp.

been so much in evidence in recent years were but the attempts by lamp manufacturers and lighting engineers to improve the lighting of the streets without having to increase the annual expenditure for gas or electricity which the addition of more lamps would have incurred. This may have been the reason why Mr. Skelton introduced in 1878 his "Catoptric" gas lamp which was designed to obtain better lighting of the road by the flat flame gas burner which was then in use. Demonstrating his invention to a number of gas engineers, Mr. Skelton said that "The light radiating upwards is no longer wasted, neither is it concentrated below or close to the lamp, but is otherwise dispersed or concentrated as may be required along the usual dark interval between the lamps." Verily, there is no new thing under the sun. The Catoptric gas lamp, Fig. I. was first used on Waterloo Bridge, and, according to the Press of the time, it had the effect of making the pavement appear a continuous ribbon of light.

Simple Re-Direction Attachments.

In this brief review we cannot consider in detail the numerous so-called directive mirror attachments and fittings to street lamps which are to be seen in variety from Land's End to John o' Groats. Of some of these "gadgets" it must be said that they are anything but satisfactory, and in some instances they appear to serve little, if any, useful purpose. They are certainly not ornamental. Mr. Langlands recently referred to "the craze for directional fittings and focussing," and said "that a certain amount of directional lighting is undoubtedly good, but, in every-day practice, the need for adjustment, and careful adjustment at that, to ensure correct focussing, raises difficulties. When a man is sent out on a tower ladder to do his cleaning he may easily send these devices awry, and the last state of that light may be very bad." One does not disparage the use of correctly designed reflecting and refracting devices to redirect some of the light to better advantage. In fact, there is much to be said for their use, but they must be fool-proof in use and capable of withstanding the more or less rough usage of "maintenance." They should also be weatherproof. One might add that the use of directional devices with a view to focussing sharply the light on the so-called B.S.I. test point, is apt to have unfortunate results. In our view indeed, the adoption of minimum illumination at the darkest point of the street as the main criterion of lighting conditions, has little to commend it.

We now propose to indicate briefly the more recent trend of development of directional lighting by gas lamps and to show that development is now along satisfactory lines.

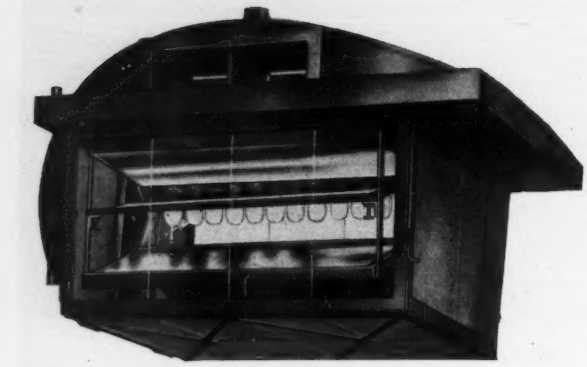
Some Modern Directional Street Lighting Systems.

The provision of special means for directional lighting to increase mid-span illumination and to reduce the diversity factor has occupied, and is still occupying, the attention of lighting engineers and lamp manufacturers, and, as a result of their co-ordinated effort, considerable progress has been made in the design and construction of lighting units to give almost any desired effect.

For simplicity, we may conveniently classify "directional" gas lamps under the following heads:—

1. Lamps which embody in their construction specular reflectors of polished metal or silvered glass;
2. Lamps which are provided with prismatic glass for re-directing the light from the source. The initial difficulties experienced by the breakage of prismatic refractors by heat have been overcome;
3. Lamps which embody in their construction reflectors and refracting equipment;
4. Lamps which are equipped with special glass globes which are not prismatic;
5. Lamps in which the directional device is incorporated in the source itself.

Lamps representative of each class are now described with their respective curves.



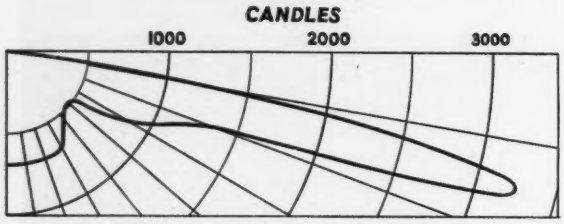


Fig. 2. View of a typical lamp of Class 1 having a straight row of 12 mantles and three pairs of glass mirrors, with Distribution Curve. (Gas Rate, 0.14 therms/hour.)

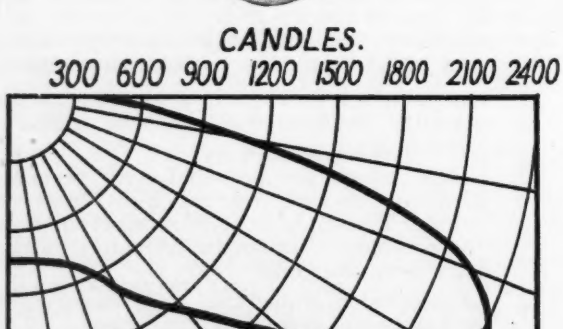


Fig. 3. H.P. Lamp in Class 1, with Distribution Curve (Gas Rate 0.14 therms/hour).

Class 1.

A typical lamp from Class 1 is that shown in Fig. 2, the essentials of which are a straight row of twelve mantles and three pairs of glass mirrors. The reflectors are adjustable and the body of the lamp is of novel design, as can be seen in this figure, which illustrates the 12-light No. 2 model. In Fig. 3 is shown another lamp of this class with its distribution curve. In this lamp the light from the mantle is redirected by external reflectors.

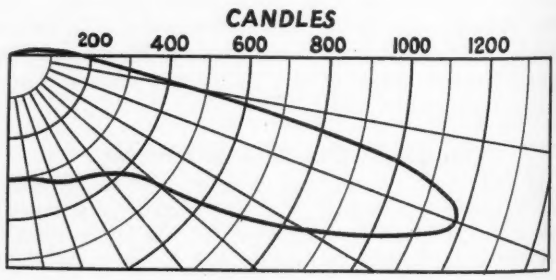


Fig. 4. Class 2 lamp, having cluster of six No. 2 mantles, with Distribution Curve (Gas rate 0.061 therms/hour).

Class 2

A representative of Class 2 is shown in the next illustration, the light source of which is a cluster of six No. 2 mantles, whose light is redistributed by a prismatic glass band and separate dish refractor. The complete lamp and the resultant distribution of the light are shown in Fig. 4. The elegant form of lamp seen in Fig. 5 with its distribution curve, also conforms with classification 2.

Fig. 5. An elegant form of lamp, also in Class 2, with Distribution Curve (Gas rate 0.081 therms/hour).

Class 3.

Our next example is a lamp in which both a reflector and a refractor are used to obtain an efficient distribution, and it therefore falls in Class 3. A photograph of the lamp and its axial distribution of light are shown in Fig. 6.

Class 4.

The method of obtaining a desirable distribution of light from a source in the lamps of Class 4 is one open to question, from the point of view of efficiency. An example of this class is afforded by a type of lamp of Continental make, in which absorption of light with some diffusion is effected in the region where the light is too intense. Fig. 7 clearly shows the nature of the globe and the general appearance of the lamp indicates that it possesses the important quality of simplicity, there being complete absence of adjustable components.

The cylindrical mantle is the light source in every type of lamp already mentioned, and the only directional effects obtained without the aid of refractors and reflectors with this source are by disposing the mantles in some form of alignment.

The Effect of the Shape of the Mantle on the Distribution of Luminous Energy.

We now propose to describe in some detail a recent development of the system of high-pressure gas lighting, particularly with regard to a more scientific direction of the light from the source. It is generally known, at least to those connected with the gas industry, that the South Metropolitan Gas Company has in recent years favoured the use of so-called high-pressure gas lamps for the illumination of the main roads of South London.

Experience with the system (which is now in use over forty-two miles of main roads) indicated that some of the light from the cylindrical mantle could be redirected with considerable advantage to the illumination of the road. A natural and logical development is to modify the existing shape of the light source, so that a greater proportion of the light should be in the desired direction.

A New Form of Gas Lamp.

In the design of the lamps to be described (to which the distinctive name "Supervia" has been attached)

Fig. 6. A lamp utilising both Refractor and Reflector (Class 3). (Gas rate 0.100 therms/hour.)

it has been borne in mind that the simplest method of obtaining a naturally asymmetrical directional and economical effect from a light source is to shape the source in such a manner that the maximum luminous area is presented towards the region requiring the maximum intensity of illumination. It is clear that, in order to use effectively the light from a single source for road illumination, the maximum area of the mantle must face up and down the road, while the minimum is presented towards the sides.

For a single source of light to give uniform road-surface illumination when centrally disposed over a straight road, it can easily be shown that the polar

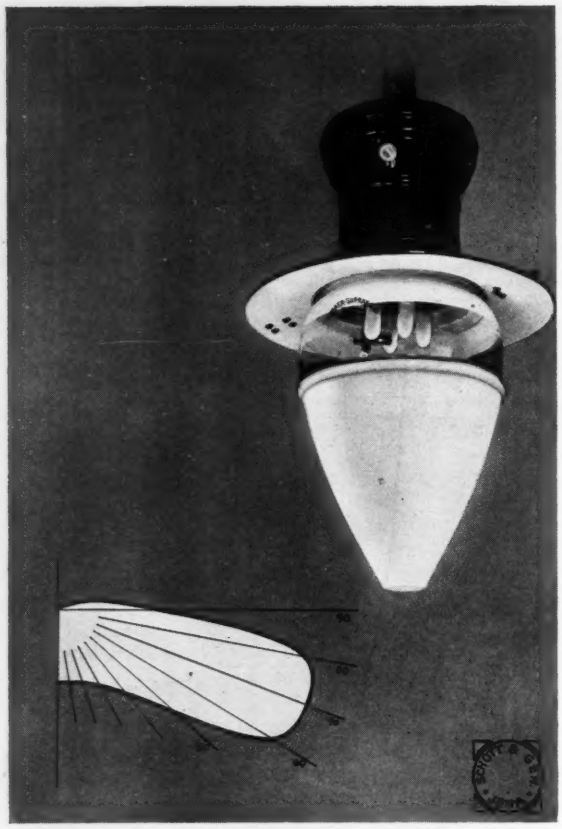


Fig. 7. A lamp of Continental make in Class 4, with Distribution Curve.

curve of the distribution in a vertical plane parallel to the road is represented by the equation

$$I = Eh^2 \sec.^3\theta$$

where:—I = Candle power at angle θ with vertical.
h = Height of source above road.
E = Horizontal illumination on road.

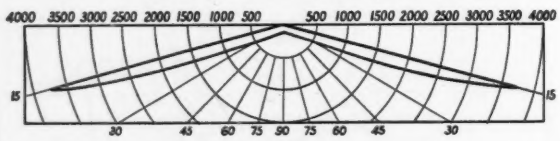


Fig. 8. Calculated Distribution Curve to give a uniform horizontal illumination of 0.16 foot-candles with source suspended 20 feet above road.

It is evident from the graph of this equation, snown in Fig. 8 that, owing to the rapid change of intensity with angle, the adjustment and disposition of a system of sources with this characteristic would be so critical, that the slightest inaccuracy would produce a disastrous result on the uniformity of illumination. The theoretically best distribution must, therefore, be tempered with the demands of practice. A compromise has been effected in these high- and low-pressure lamps of the new type, in the design of which are incorporated efficient, directional illuminating characteristics with the minimum of maintenance difficulties.

The "Supervia" High Pressure Lamp.

The fundamental principle stated above has been made the basis for the lamp design, a design which has necessitated the production of a special rectangular mantle which is used as the asymmetrical light source. Fig. 9 is a photograph of the larger of the two standard H.P. lamps. In it the rectangular mantle, the fabric of which is supported by a nichrome wire frame, can be seen held just below the superheater, which is made of a special heat-resisting alloy.

The mantle is clamped to the burner by two wing nuts and is heated by the flame issuing from the rectangular nozzle of dimensions 1-16 in. x 4 in. The mantle dimensions are such that the fabric occupies the hottest part of the highly aerated flame, thus ensuring maximum luminous efficiency. While the directional effect of the bare mantle is a

Fig. 9. A general view of the new "Supervia" H.P. Lamp, showing special slot burner and rectangular mantle.

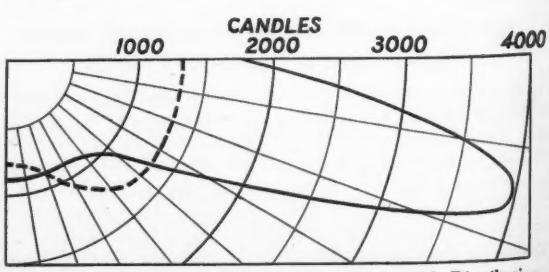


Fig. 10. "Supervia" H.P. Lamp, complete with Distribution Curve (full). (Gas Rate 0.107 therms/hour.) Also Distribution Curve of Non-Directional H.P. Lamp (broken). (Gas Rate 0.121 therms/hour.)

great advance on that afforded by the conventional, cylindrical mantle, the desired distribution is not fully obtained. In Fig. 10 the refractor dish used to accomplish the final re-direction is seen. This is supported by a chromium-plated frame, which positively ensures the correct position of the dish relative to the mantle. The complete burner is surrounded by a clear glass globe, which protects the unit from the weather.

For centrally suspended lamps the refractor is of symmetrical design and the lamp is placed with the mantle presenting its maximum area up and down the road. In this position the light distribution in a vertical plane parallel to the road-length is as shown in Fig. 10, with the corresponding distribution from a cylindrical mantle. Light, which in the latter case was directed towards the side of, and beyond, the road, is in the former case directed on to the road surface.

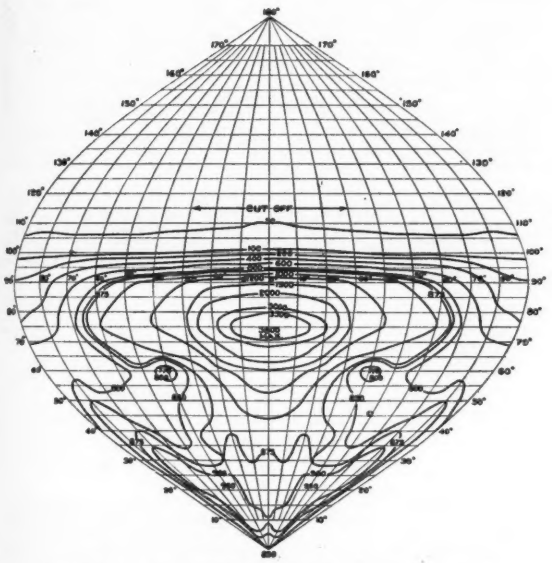


Fig. 11a. Isocandle diagram of "Supervia" No. 1 H.P. Lamp. (Gas Rate 0.107 therms/hour.)

Figs. 11a and 11b show the iso-candle diagrams of "Supervia" and cylindrical mantle lamps.

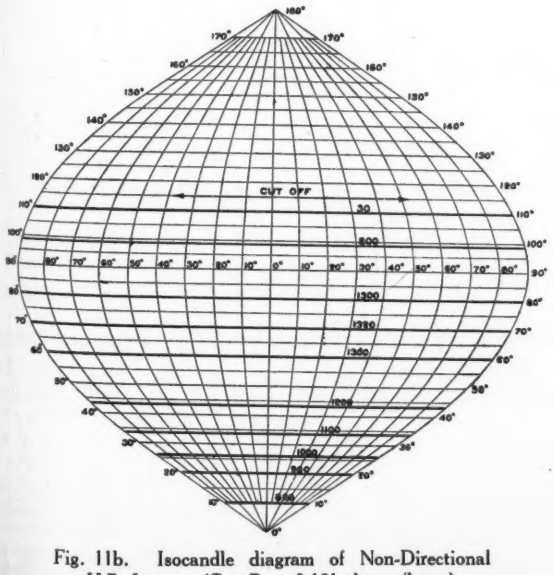


Fig. 11b. Isocandle diagram of Non-Directional H.P. Lamp. (Gas Rate 0.121 therms/hour.)

Road Surface Test Results with High Pressure Lamps.

In Figs. 12a and 12b are given results of tests of horizontal illumination on the road in South-street, Greenwich, with (a) H.P. Supervia lamps, (b) H.P. cylindrical mantle lamps. In each system

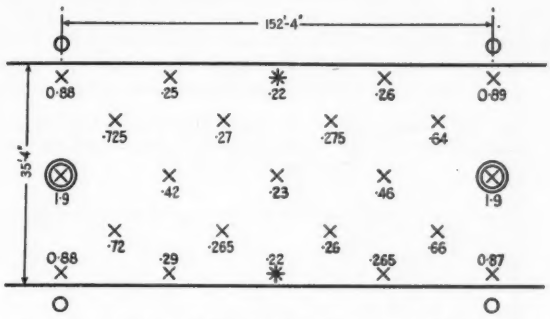


Fig. 12a. Horizontal Illumination Measurements South Street, Greenwich, lighted by "Supervia" No. 1 H.P. Lamps (Diversity Coefficient 8.6 : 1).

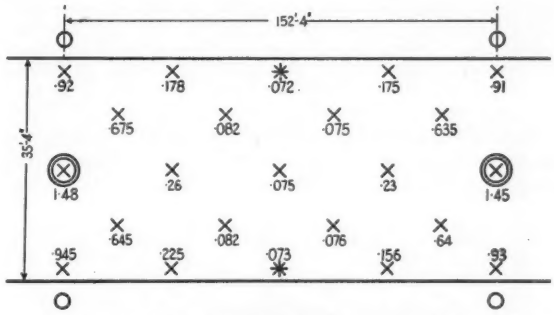


Fig. 12b. Horizontal Illumination Measurements South Street, Greenwich, lighted by non-directional H.P. Lamps. (Diversity Coefficient 20.5 : 1.)

the lamps are mounted in identical positions, and the rates of gas supply are the same. The diversity factor in the case of (a) was 8.6, and in (b) it was 20.5. The use of the new lamps effected a marked improvement in the uniformity of the illumination, which is clearly depicted by the widening of the contour lines of equal intensity in the corresponding isolux diagrams, Figs. 13a and 13b. It will also be seen that the minimum intensity of illumination is increased threefold by the redistribution. Sinusoidal projections of the intensity distribution and the road boundaries show that there is a twenty-five per cent. increase in the quantity of light falling on the road surface in the case of the new type of lamp as compared with that from lamps using the cylindrical mantle.

The Low Pressure Lamp.

The low pressure lamp has been developed on the same principle of maximum luminous surface to be presented to the direction requiring maximum intensity. The rectangular mantle in these lamps is heated by the flame issuing from a rectangular slot in a refractory nozzle. Refracting dishes are used with the single mantle type lamps in order to obtain the required distribution.

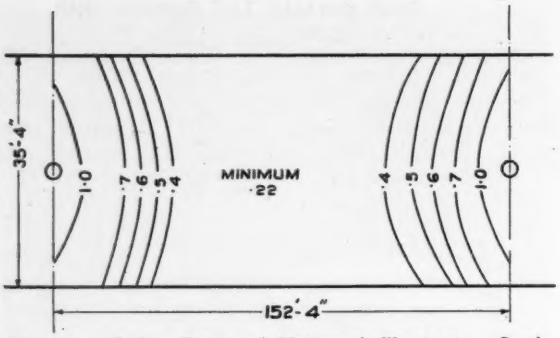


Fig. 13a. Isolux Curves of Horizontal Illumination South Street, Greenwich, lighted by "Supervia" No 1 H.P. Lamps. (Mounting Height 20 ft.)

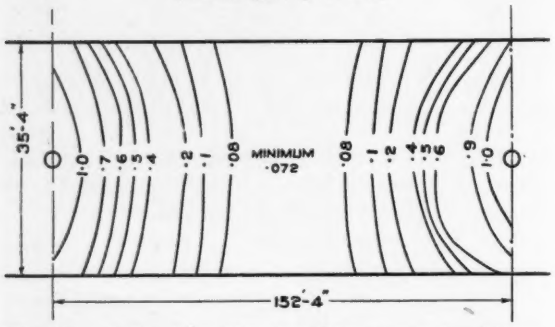
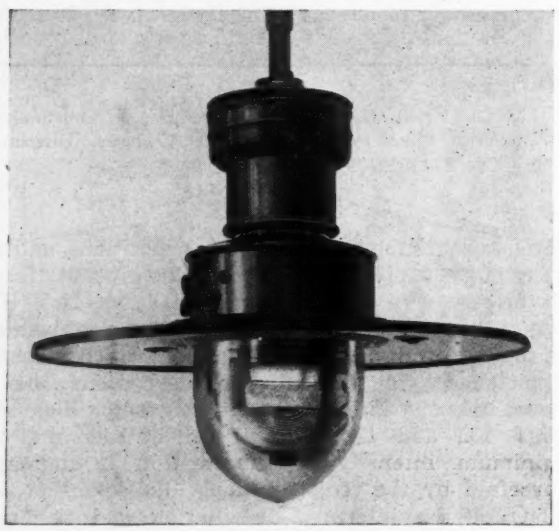


Fig. 13b. Isolux lines of Horizontal Illumination South Street, Greenwich, lighted by non-directionaal H.P. Lamps. (Mounting Height 20 ft.)

Fig. 14 shows the "G" type of L.P. lamp complete with its axial distribution curve and the corresponding curve of a 2-lt. No. 2 non-directional lamp.



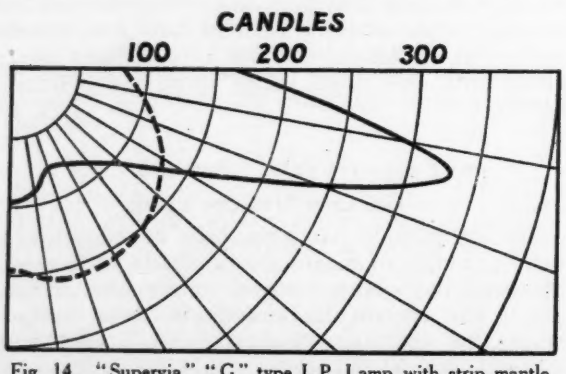


Fig 14. "Supervia" "G" type L.P. Lamp with strip mantle (Gas Rate 0.021 therms/hour). Distribution Curves (full) in comparison with non-directional lamp of similar consumption (broken).

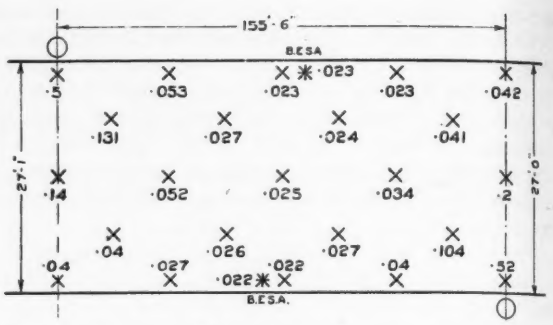


Fig. 15a. Horizontal Illumination Measurements of road lighted by "Supervia" "G" type L.P. Lamps (Diversity Coefficient 23.6 : 1).

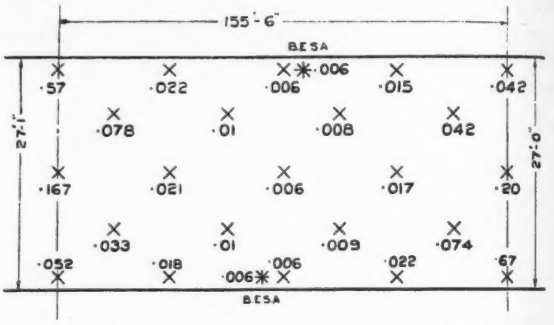


Fig. 15b. Horizontal Illumination Measurements of road lighted by non-directional L.P. Lamps. (Diversity Coefficient 112 : 1.)

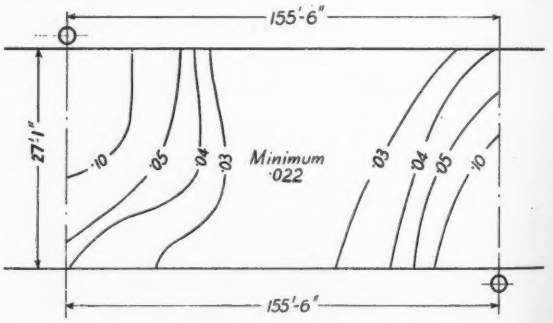


Fig. 16a. Isolux lines of Horizontal Illumination of road lighted by "Supervia" "G" type L.P. lamps. (Mounting Height 15 ft.)

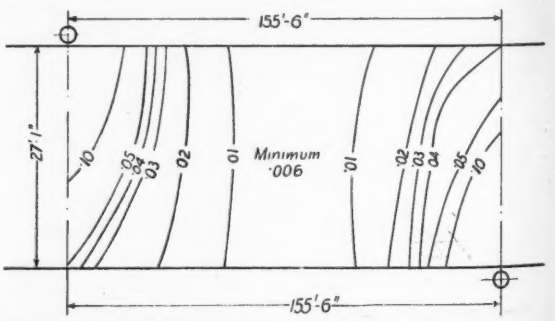


Fig. 16b. Isolux lines of Horizontal Illumination of road lighted by non-directional L.P. Lamps. (Mounting Height 15 ft.)

Road Surface Test Results with Low Pressure Lamps.

Figs. 15a and 15b show actual horizontal illumination measurements made in a residential road lit by (a) the "G" "Supervia" lamps and (b) by the non-directional lamps. The spacing and height in the two tests shown were identical and the gas rate of each tye of lamp was the same. The advantageous redistribution of the light is evident from the isolux diagrams, Figs 16a and 16b.

A more uniform illumination is obtained with the "Supervia" lighting, as is shown by its diversity

factor of 22.6, as compared with 112 obtained with the non-directional lamp. The minimum has been increased nearly fourfold, thus bringing the unclassified illumination into class "G."

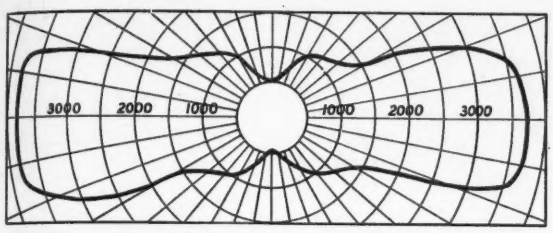


Fig. 17a. Azimuthal distribution curve 15° below horizontal effected by an axial dish refractor with a rectangular mantle.

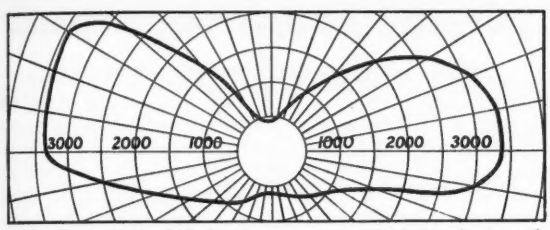


Fig. 17b. Azimuthal distribution curve 15° below horizontal effected by a non-axial dish refractor with a rectangular mantle.

With side-suspended lamps, as used in this case, a non-axial, asymmetric refractor is used which has the effect of displacing the symmetrical distribution "en bloc" 15° towards the road, as shown in Figs. 17a and 17b.

The Multiple-Mantle Low Pressure Lamp.

For thoroughfares requiring more brilliant illumination by means of L.P. gas, more powerful units of the new lamps, which possess equally effective illuminating properties, are available.

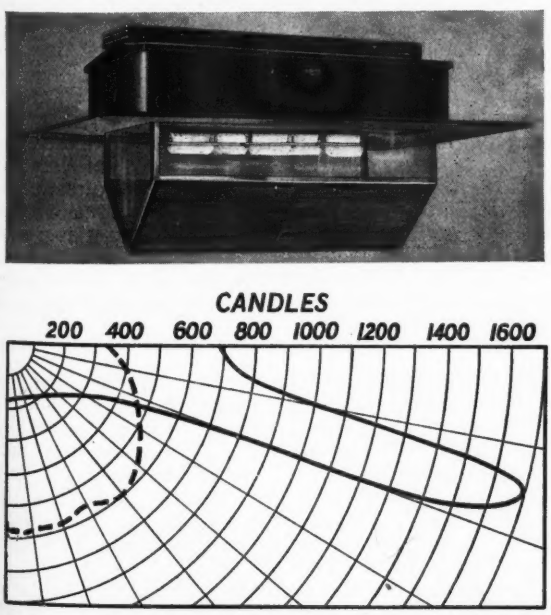


Fig. 18. "Supervia" "E" type L.P. Lamp with distribution curve (full) (Gas Rate 0.111 therms/hour). Also distribution curve (broken) for non-directional lamp (Gas Rate 0.112 therms / hour).

In Fig. 18 a multiple mantle "Supervia E." type lamp is shown, with its axial distribution curve and the corresponding curve of an 8-lt. No. 2 non-directional lamp. For comparison of actual performance of the lamps, test measurements on a main road lit by these lamps, mounted at the same height on the same poles and consuming gas at the same rate, are given in detail in Figs. 19a and 19b, which are also represented pictorially in Figs. 20a and 20b. The directional lamp results in (a) show the diversity factor by this lighting to be 4.1, while in the case of the non-directional lamps (b) this factor is 31. It will be seen that the minimum intensity of illumination has been increased nearly four times by the substitution of the directional lamps.

The uniformity of road illumination, as illustrated by the photographs shown of important thoroughfares at night lit by installations of "Supervia" lamps, bear out the photometric test results.

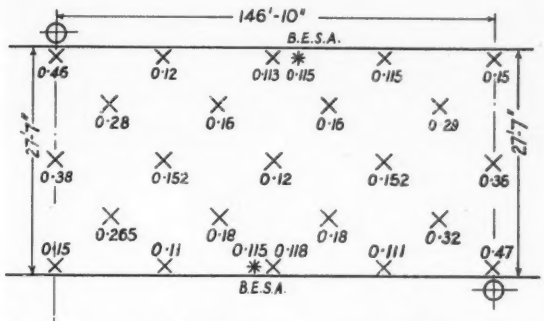


Fig. 19a. Horizontal Illumination measurement of road lighted by "Supervia" "E" type L.P. lamps. (Diversity coefficient 4.1: 1).

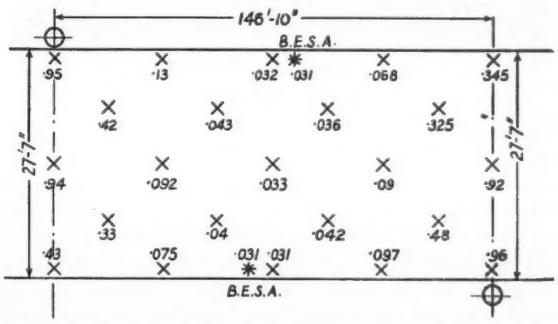


Fig. 19b. Horizontal Illumination measurements of road lighted by non-directional L.P. lamps (Diversity coefficient 31 : 1.)

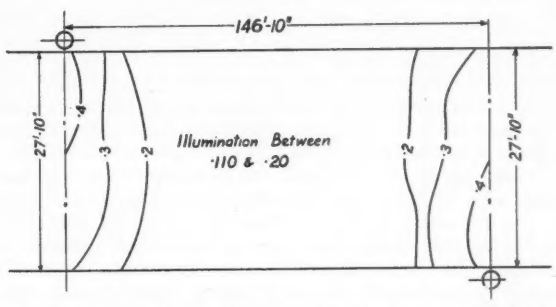


Fig. 20a. Isolux lines of Horizontal Illumination on road lighted by "Supervia" "E" type L.P. lamps (Mounting Height 20 ft.)

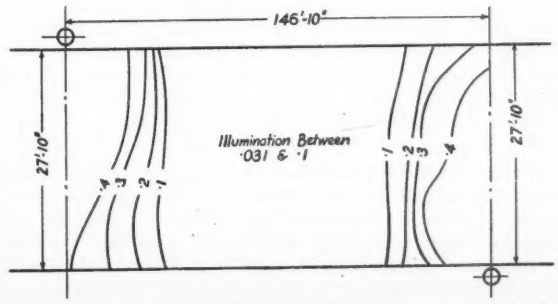


Fig. 20b. Isolux lines of Horizontal Illumination on road lighted by non-directional L.P. lamps (Mounting Height 20 ft.).

It has been remembered throughout the designing of these lamps that, important as is the attainment of good directional characteristics, their correct application is equally vital. This is a condition that can only be ensured by making the units as simple as possible, with adjustments which are not ultra-sensitive. In the hands of the maintenance staff the practicability of the lamps has been proved; indeed, as can be judged from the details given and photographs shown, they call for no more maintenance than that required by lamps of a simple non-directional type.

Fig. 21. Installation of "Supervia" Lamps at Brixton Hill, S.W.

Fig. 22. Installation of "Supervia" Lamps at South Street, Greenwich, S.E.

Acknowledgments.

We wish to express our thanks to Dr. Carpenter, President of the South Metropolitan Gas Company, for facilities granted for the preparation of this paper, and to colleagues, more particularly Dr. J. S. G. Thomas and Mr. J. B. Carne, B.Sc., for their valuable assistance in collecting the necessary material.

DISCUSSION

Dr. S. ENGLISH (London) remarked that this paper extended and amplified, so far as gas street lighting was concerned, the paper which he had read at Aberdeen last year. On that occasion he referred to the possibility of making prismatic heat-resisting glass sufficiently durable to withstand high-pressure gas. He had also stated that to have obtained glass sufficiently heat-resisting to stand up to ordinary pressure gas was an achievement, and that he was somewhat doubtful of further progress. It was therefore a matter of some surprise to him when Mr. Chandler had showed him his new high-pressure lamp glass, which was standing up without any trouble at all.

Continuing, Dr. English congratulated the authors upon the remarkable advance that had been made in gas street lighting by the adoption of the peculiarly shaped strip mantle. It would be interesting to know in that connection whether that particular shape gave better street lighting distribution than the ordinary inverted cylindrical mantle; it seemed to him quite likely that that strip mantle would probably give a somewhat better distribution than a number of small mantles arranged in linear formation, but he would like to know whether the strip mantle gave a sufficiently improved distribution to justify its use, having in mind that the strip mantle was probably more fragile than the small indirect mantles.

Mr. C. HARPER (Assistant Borough Engineer, Barking) referred to the statement in the paper attributed to Mr. Walter Garner that, "His experience as a motorist was that the safest road was one in which there was no lighting at all!", and said presumably the exclamation mark was intended to express surprise, but he himself was surprised at the surprise because he entirely agreed with that statement. If he were behind really good head-lamps he felt competent to tackle anything that might arise.

Referring to the comment in the paper on peripheral vision, he suggested that this did not tell the whole story, because it did not make any reference to the extreme rapidity with which the human eye could change its direction of vision. Further, the comments in the paper on this subject left out another important factor, namely, the question of retention of visual impression. Theoretically, it might be assumed that if one were looking at a postcard only a small central area would be clear and the rest a blur. But actually, owing to the rapidity of movement of the eye the whole postcard appeared clear to the observer.

Mr. C. H. WOODWARD (Bournemouth), remarked that in the Supervia lamp, "all eggs were in one basket." With a number of small mantles, if one mantle happened to go only a small percentage of the total light was lost, whereas in the case of the Supervia lamp there was apparently a total loss of light if the one mantle failed. Therefore, he asked for the authors' views on the question of reliability of the new lamp from this point of view.

Speaking from the point of view of the motorist, and the question of foveal and peripheral vision, Mr. Woodward said the angle of actual vision was in the region of 160°. Without enlarging upon the question of blurring outside the foveal area, he might draw the attention of motorists to a particular matter. When meeting cross roads there was the choice of two things, either to look to the left first and then the right, or vice versa. Personally, he preferred, in taking cross roads, to go slowly, and instead of looking either to the right or the left to make use of marginal vision to act as a scout to warn him which

way actually to look. That was really the whole process of vision both by day and by night, although we might not be conscious of it. The area of foveal vision was so small that unconsciously we made use of peripheral vision as a form of scout which was sent out in order to give a warning which way to direct the acute vision.

Commenting upon the recommendation in the Highway Code that drivers should drive within the capacity of their braking accommodation, Mr. Woodward expressed the hope that he would eventually find another recommendation in the Highway Code that a driver should not drive beyond the accommodation of visibility. There were many occasions in which a driver ran into a spot where there was practically no visibility, and speed should be reduced considerably. In his own experience there had been times when he had been very thankful he was going slow in such circumstances because there had been cyclists in his way whom he had not seen.

Mr. G. H. WILSON (Research Laboratories, General Electric Company) said that he himself had inspected a number of installations, using the new gas units described in the paper, and had found many of them to be excellent—although from the iso-foot-candle diagrams given in the paper, it was not possible to judge installations. At the same time, he thought, their excellence he had observed was not due to compliance with the essential requirement No. 3, given in the paper, which stated that the units should give as far as possible uniform illumination between the lamps. The authors also stated that the provision of special means for directing the lighting to increase mid-span illumination and to reduce diversity factor was occupying the attention of lighting engineers, and in another part of the paper remarked that the use of directioned devices with a view to focussing sharply the light on the so-called B.S.I. test point was apt to have unfortunate results. He would like to have some explanation from the authors why doing the one thing was apt to have unfortunate results, and doing the other, which seemed very similar, was an essential requirement. Personally, he did not think the authors had carried their analysis quite to the final conclusion. He believed that an ordinary observer did not want to see uniform illumination, but what was commonly called uniform lighting, or expressing it more technically, uniform brightness of the area that was seen. Perhaps that was what the authors meant, although they did not express it in that way in the paper. He felt convinced that if the authors were able to obtain the theoretical curve shown in Fig. 8 with a lantern which was erected at normal heights and normal spacings they would produce an installation which would satisfy nobody. On account of the variations in road surface it would not be possible to obtain uniform lighting with a polar curve of that type, although it would be possible if the ground were snow covered. Under normal conditions, however, it would inevitably produce light and dark areas.

Finally, Mr. Wilson put in a plea for some standard convention with regard to the viewpoint from which photographs of street lighting were taken, and suggested that the camera should be placed about 10 ft. from the near-side of the curb and about 5 ft. high, which, he said, represented the normal position of the driver of a vehicle.

Mr. J. I. BERNARD (British Electrical Development Association) said there was some danger in taking, as the paper seemed inclined to do, the viewpoint of the ordinary citizen as being the all-important one. The ordinary pedestrian was often inclined to judge a lighting installation by looking at the lamp and observing its brightness. After all, it was the surface brightness of the road and the background which was all-important, and the best judge of this surely was the driver of a fast-moving vehicle. It could safely be said that most street lighting installations enabled the pedestrian to find his way about the roads easily, but the more competent critic was surely the driver of a motor vehicle whose judgment must be based on the visibility and the ease with which he could distinguish objects on the road. Whilst agreeing with the authors' first essential requirement, and stating that unless there was sufficient total flux from the light sources it would be impossible to get satisfactory illumination no matter what gadgets or arrangements were in the lantern, Mr. Bernard, referring to the second essential requirement of low intrinsic brilliance, said this depended on whether the source was screened or not. When there was a refractor between the source and the observer, then surely it was the beam candle-power which determined the glare, and even when there was no refractor it must be borne in mind that in the ordinary view in a busy street there were probably many other light sources of high intrinsic brilliance over which the public lighting engineer had no control. The third requirement as to uniform illumination was, as the authors stated, open to dispute, and what really mattered, as Mr. Wilson had said, was that there should be uniform brightness on the road surface and pavement, because only in that way could uniform visibility be obtained. With regard to the fourth and fifth requirements relating to ease of maintenance of lanterns and light sources, there might be some doubts as to the possibility of maintaining the flat mantle in good condition easily.

Finally, Mr. Bernard agreed with the authors that cost was the crux of the whole question of street lighting, and mentioned that in America where, during the depression in recent years, some towns had decided to reduce the expenditure on public lighting, statistics had shown that the saving so made was far more than counterbalanced by the increased traffic accidents which had occurred. In other words, the community had to pay more in accident risks than had been saved in the reduced cost of street lighting. This was a very important matter, having regard to the increased traffic risks now existing in this country, and should have a great influence upon local authorities in their street lighting policy.

Mr. F. C. SMITH (Research Laboratories, Gas, Light and Coke Company) spoke of the immense amount of work which the authors and their colleagues had put into the production of the new lamp, and of the great amount of research that had been involved in getting the physics of the burner right. Commenting on what had been said as to expressing illumination to the second place of decimals, Mr. Smith remarked that although this might be foolish, generally speaking, it had to be remembered that the second place of decimals might represent 10 per cent., and sometimes contracts turned on a difference of 10 per cent. Continuing, he said he would not enter into the controversies of road brightness and road illumination; there were people who believed road brightness was the right thing, and those who believed illumination was the right thing, but a point which the authors had not mentioned was that the Supervia lamp enabled both schools of thought to be satisfied. By a simple movement of the refractor it was possible to throw a beam up to about 10° below the horizontal, and it was also possible to get a high intensity at 75° or 70°. If the municipal engineer had a road surface which demanded road brightness, he could have it. On the other hand, if he wished to pass the B.S.I. test point the lamp also enabled this to be done. Its flexibility was a real advantage at a time when those concerned with street lighting were a little uncertain as to which way the tendency would develop. A further real advantage of this lamp was the ability to reduce the pressure so as to lower the intensity, and, of course, effect a corresponding saving. There were many installa-

tions in which a number of lamps were put out at midnight which, of course, completely altered the lighting plan of the illuminating engineer, but the ability with the Supervia lamp to reduce the candle-power by a reduction of pressure and to keep all the lamps alight was an immense advantage. From the point of view of the gas industry he regarded this lamp as making lighting history.

Mr. J. F. COLQUHOUN (Sheffield) said he could not quite understand the statement in the paper "In our view, indeed, the adoption of minimum illumination at the darkest point of the street as the main criterion of lighting conditions has little to commend it." That was hardly a fair statement, because the test point illumination had no right to be termed the main consideration. If any of the other regulations of the specification, such as mounting height, spacing, etc., were broken, then they departed from the specification just as much as if they had fallen short of any desired illumination of the test point. Mr. Colquhoun also pointed out that in Fig. 13a the minimum illumination was 0.22, and this was raised from 0.072 in Fig. 13b. Would the authors say whether the disability by so raising the minimum illumination had or had not been increased? If it had not been increased, he would like to know why the authors went to the trouble of raising the minimum illumination. The point was that on the one hand the authors criticised minimum illumination and, on the other hand, exercised considerable ingenuity in raising it.

Mr. D. G. SANDEMAN (Edinburgh) expressed his interest in the new lamp. A point of criticism about it, however, was that from the curves it gave only about 2,000 candle-power at the horizontal and the maximum brightness at 15°. Was this 15° arrived at from theoretical considerations, or had the authors found that this gave the best results? In conclusion, Mr. Sandeman mentioned the case of a road in Edinburgh which was lighted on one side with lamps spaced at a distance of sixty yards, the road being about 120 feet wide. Highly directive fittings which were capable of adjustment were used. According to the maker's instructions, the beams were adjusted to 15° below the horizontal, but it was found by raising the beam to about 5° below the horizontal very much improved results were obtained, and the Committee had refused to sanction any alteration in the installation having seen this improved result.

Mr. J. M. WALDRAM (Research Laboratories, General Electric Company), commenting on the different distributions shown in the curves in the paper, said these could be divided into different types, and no doubt the authors had arrived at some conclusions as to which type gave the better results. Mr. Sandeman had just given an example of what could be done by an apparently small change in distribution, and he himself had been concerned with an installation in which by raising the peak of distribution from 15° below the horizontal to 5° below the horizontal it had been possible to halve the illumination and double the brightness on the road.

Mr. CHANDLER, replying first to the point raised by Dr. English as to the comparison between the strip mantle and multiple mantles in linear form, said a comparison had been made of the Supervia lamp and a lamp with four mantles in linear formation. The energy input in both cases was precisely the same and the area of the fabric was identical. A photometric test showed that the increase in light from the strip mantle was 60 per cent., as compared with the other type. The question of glare was an ever-recurring one and had been discussed *ad nauseam* like so many other matters in connection with public lighting. He suggested that those who availed themselves of the opportunity of seeing the installation in the Blackfriars-road, would be able to form their own judgment as to whether the brightness was excessive or not. He himself had found that it was possible to stare at one of the Supervia lamps for ten minutes with the beam fifteen degrees below the horizontal, and then to drop a coin and be able to see it quite easily.

In reply to Mr. Harper on the question of vision, Mr. Chandler said this question had been raised because there was such a thing known as the fixation of vision. It was a remarkable thing to what extent the vision of the eye varied with human beings. He had been told that 40 per cent. of people suffered from a disability in this regard; for example, when driving a car the vision generally was fixed at some point in front and did not wander all over the place. That was one of the points they had in mind in speaking of peripheral vision. With regard to the strength of mantles, experience had shown that the strip mantle was stronger than the multiple mantles owing to the method of attachment. So far, at any rate, there had been no trouble from this cause. The question of the projection of the beam on to the test point, mentioned by Mr. Wilson, could be argued about in an interminable manner. He agreed with Mr. Wilson that some standard should be fixed for photographic work in connection with public lighting because of the extraordinary effects that could be produced in the absence of any standard. As to curves 13a and 13b, he assured Mr. Colquhoun that the illumination in 13a was a very large improvement as compared with 13b. Replying to Mr. Sandeman, it was stated that the maximum beam of fifteen degrees below the horizontal had been decided upon as in all the determinations and observations recorded in the paper there was a spacing distance of 150 ft., and a height of 22 ft.; fifteen degrees had been determined as the correct angle for the distribution of light in the main beam. Whilst thanking Mr. Smith for his kind remarks, Mr. Chandler said he was bound to say in reply that the work being done at Watson House by Mr. Smith and his colleagues was such as would lead the gas industry into wider fields in the future. There was collaboration between the two large London gas companies and the work being done by them should be extremely helpful to the gas industry in the future.

Street Lighting and Traffic Problems

When proposing the toast of "The Association of Public Lighting Engineers" at the luncheon on September 10, Sir Henry Maybury recalled that the subjects of road traffic, road safety, and street lighting had been constantly under review during his Chairmanship of the London Traffic Committee. Different views were held by various local authorities; streets sometimes formed borough boundaries, with the result that one found different types of lighting on the two sides of the roadway! He alluded to the work of the M.O.T. Street-lighting Committee, which, it was hoped, would lead to advances. But in the meantime he wished to offer congratulations on the great improvement made in the lighting of large centres of population during the last few years. The lighting of some streets in the Metropolis might serve as a pattern to the world. In the immediate post-war years his department had been responsible for the construction of some 200 miles of new arterial roads in the London traffic area. At that time, neither the Minister of Transport nor the County Councils were empowered by Statute to make any contribution towards the lighting of these new and important highways, which was often a burden to local authorities. He hoped that some day the desire for more equitable distribution of the cost of such work would be gratified. Sir Henry quoted figures to show the great increase in traffic, which was finding its way into the less important highways. More attention might well be paid to the lighting of such subsidiary routes. He recalled a suggestion that commercial people should relieve the main traffic by diverting their vans to some seventeen miles of little used streets. He was told that they would use them if these streets could be better lighted. Sir Henry concluded by wishing the Association success in its arduous and responsible work.

Developments in Electric Lighting in London

By W. J. ALLBRIGHT *(South Metropolitan Electric Light & Power Co., Ltd., and South London Electric Supply Corporation, Ltd.)*

(Delivered at the Twelfth Annual Meeting and Conference of the Association of Public Lighting Engineers, held in London during September 9th to 12th, 1935.)

Introduction.

I feel it to be my duty in presenting this paper to preface it by a word or two of explanation as to its purpose and scope.

In the first place, it is emphatically not a scientific, educational treatise intended to introduce new discoveries or principles, or to lay down the correct technical regulations which govern, or should govern, modern street lighting. In the second place, it is not my intention to enter into detailed controversial criticism—except, perhaps, by a mere passing reference to their existence—of the various methods of street lighting, either of the design of illuminating agents, or the application of the various types of apparatus embodying them.

I gather from a perusal of the titles of papers which are to be presented to you that the technically scientific aspects, of several phases of the subject at any rate, are to be dealt with by competent authors, and I may be excused, therefore, from duplicating their expert opinions.

My object is to give you, in an informal manner, a résumé of the various phases which London street lighting has assumed, and to bring before you its present position and apparent trend. I suppose I have been asked to undertake this task because my forty-five-year association with the electrical industry has enabled me personally to witness most of the great changes in street lighting methods, of the traffic growth in London which has necessitated them, and the requirements of which grow more pressing every year. The importance of the subject generally cannot be over-emphasised, and the fact that Committees are sitting this year with references practically wholly confined to street lighting problems, is sufficient evidence of Governmental interest.

You will observe that I have divided the paper into sections, and these preliminary explanations apply to all of them.

It is really extraordinary when one comes to think of it that the real growth in London street lighting methods, and in the growth of the degree of illumination given, and of visibility in dark hours, has practically all taken place in a lifetime; and when one contemplates the enormous extent of the growth from candle or oil lanterns to high intensity gas or electric lamps, one cannot but be amazed at the rapidity of the progress, and of its extent. There seems no indication either that the progress is slowing up, or the call for greater lighting decreasing. On the contrary, the cry is "more light." The particulars I give later, in the section on Progress, amply illustrate the point.

An interesting case is presented by the Victoria Embankment (Fig. 1), for which comparative data illustrating the lighting conditions at various periods happen to be available. You will observe how greatly these conditions have changed—the latest development being only a few years old.

CHANGES IN THE LIGHTING OF THE VICTORIA EMBANKMENT
(Westminster Bridge to Blackfriars Bridge).

Date	No. of Units	Type	Approximate total C.P. of lamps
Before 1882	222	Flat Flame Gas Burners	2,720
1882	50	Jablochkoff Electric Arcs.	13,250
1914	66	Flame Arc. Lamps (Central)	192,000
	140	Metal Filament Lamps	
	20	Incandescent Gas Lamps	
About 1918	57	500 watt GF Filament Lamps	58,000
	69	300 watt GF Filament Lamps	
	96	60 watt Vacuum Filament Lamps	
1929	100	1,500 watt GF Filament Lamps (in refractor lanterns)	229,000

Fig. 1.

London.

It will be noticed from the title of the paper that I am to deal with the progress of street lighting "*in London.*" In view of the very rapid growth of Greater London, it is difficult to define the limits of my observations, but I have, in the main, considered what might be called the Metropolitan Boroughs of London without its outer ring growths.

Street lighting was originally installed mainly to prevent crime, and as a guide to horse-cabs and other horse traffic which, in the early days, were not difficult to cope with by quite inferior lighting methods, e.g., the very early oil lamps, and the later means of lighting by fish-tail gas burners, introduced in or about 1813, served for quite a considerable period. The

great increase, however, in normal road traffic, and even pedestrian traffic in the Metropolitan Boroughs —which, by the way, cover about 117 square miles, and are inhabited by approximately four to five million people—made it necessary for re-consideration to be given to the subject of lighting, if safety was to to be provided on the roads by the authorities.

This fact, and the example set in America, in particular, of the advertising use of brilliant lighting, has certainly in the last ten to fifteen years resulted in considerable improvements in London lighting. Unfortunately, London cannot be said, even now, to have a uniformly high standard of lighting.

There are several areas which stand out as exceptions to this general rule, and I give below examples showing what progress has been made, but the general level of lighting, particularly in secondary or side roads, leaves much to be desired.

Traffic Growth.

I have mentioned above the fact that improved lighting has been fostered and, in fact, necessitated, by the growth of traffic, and I have shown in Fig. 2 the growth in the number of licensed vehicles in the country, which also shows the great growth in traffic during recent years. Some of you have doubtless seen statistical returns showing the vast volume of traffic which has to be dealt with on some of the main roads out of London, particularly during holiday seasons and week-ends, and the recent Ministry of Transport survey should give useful information.

Attempts have been made in the past by such statistics to show that the number of resultant accidents has been decreased as improved street lighting was installed, but, unfortunately, these statistics have never contained full data on the subject of the safety and density of traffic. I have not been able definitely to show from statistics in my own areas that this resultant safety has been marked since the installation of the extensive degree of lighting now available. I do not think, however, it can be disputed that adequate lighting improvements do have a very considerable bearing on the freedom from traffic accidents, and common sense will make it obvious that if traffic — both pedestrian and vehicular — is to flow as smoothly and safely by night as by day, an approach to daylight lighting should be aimed at, and the better plan, and in fact the ideal, would surely be to provide daylight illumination by artificial means during night hours!

In towns, in my opinion, headlights on cars should be prohibited, for it is now quite possible to obtain at a reasonable commercial price lighting quite sufficiently good to obviate the need for such aids. They should, therefore, be restricted to unlighted country roads.

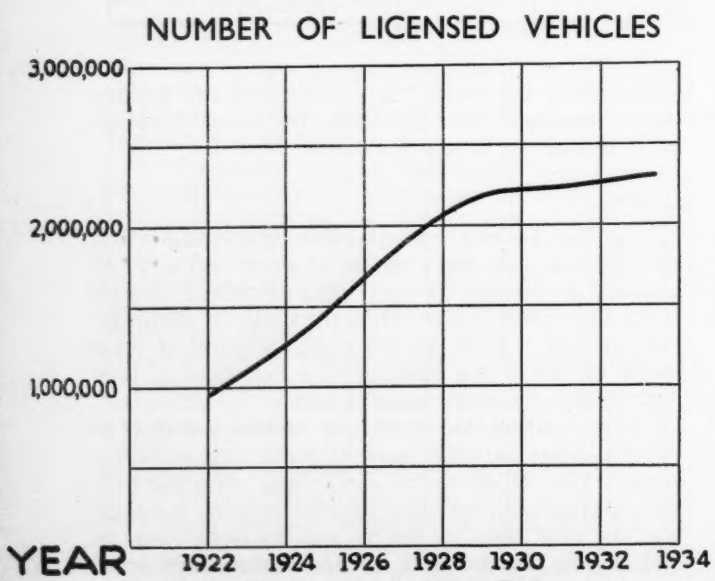


Fig. 2. Illustrating Growth of Motor Traffic.

Lighting Values.

The lighting of a street, and in fact of rooms, has in the past been defined by reference to certain minimum foot-candle values on the surface. The usual levels of illumination which are provided normally are illustrated on the diagram (Fig. 3), which I present, upon which the white areas represent foot-candles, based on the present British Standards Institution Specification. While, however, this

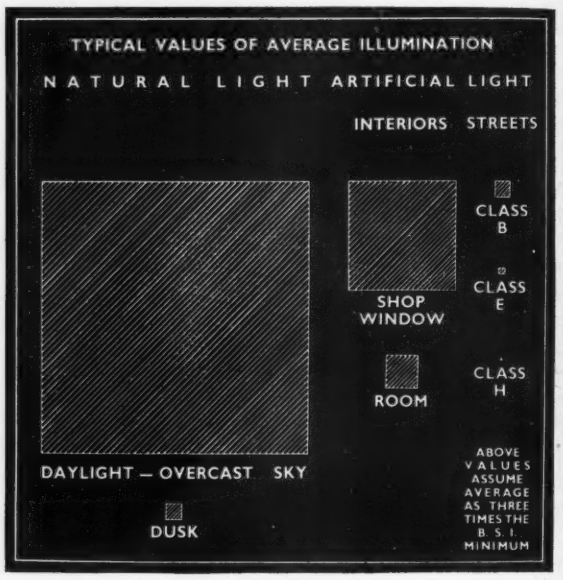


Fig. 3. Illustrating contrast between Natural Light and Artificial Lighting of Streets.

specification has been of great service in the past as providing, at any rate, *some* standard to be aimed at, it does not, in my opinion, provide a criterion of the effective value of road-surface lighting, into which other considerations, to be discussed later, undoubtedly enter. The method, too, has led to classification in fractions of a foot-candle, and to endeavours by various well-meaning road surveyors to define the lighting in fractional parts in the classified list. This has gone so far in certain cases as to define whether a street has a minimum illumination running into a second place of decimals, as for example, in class "E" in the specifications, a value of say 0.11; or in class "F" a value of say 0.09 foot-candles. The absurdity of such delicate calculations for road lighting purposes is, I think, obvious from a reference to the above-mentioned diagram, from which it will be seen that in many places four to eight times the quantity of light given in a road is needed to bring it up to a reasonable standard. Such fine distinctions as a second place of decimals in foot-candles are almost Gilbertian.

Quite apart from this point, however, I am of the opinion that some means of metering or measuring "visibility" rather than foot-candles on a horizontal test plate is needed in order to give a good guide. It is brightness of the road surface as seen by the road user which should be the basis for the measurement of the efficiency of all road-lighting schemes, whereas it seems to me that the measurement of the foot-candles on the horizontal test plate gives the effect of the lighting as viewed by an observer in an airplane, or one stationed at some considerable height above the road. Admitting, therefore, the usefulness

of the B.S.I. Specification, I am strongly of the opinion that the chief improvements in street lighting must be tested by some means of determining "visibility" which the "man in the street" is able to use and appreciate. A badly lighted street, if it is to be converted to a well-lighted street may need twice as many posts, or lamps of four or five times the power, or even both, but, unless the method of improvement is such as to provide the road user with an evenly bright surface two or three hundred yards ahead of him, it means money more or less wasted. It would be small comfort to a road user, who finds the visibility poor and patchy, to be "fobbed off" with the knowledge that certain parts of the area are really lighted to some small decimal fraction of a foot-candle in B.S.I. Standards.

General History of London's Electric Street Lighting.

As mentioned in the opening portion of this article, the writer has had the advantage of living through practically the whole era covered by public electric lighting, and he well remembers the early attempts to introduce the new system in various London thoroughfares.

Historical Data.

The invention of the carbon arc lamp, with its extraordinary degree of brilliancy, naturally led inventors and enthusiastic engineers to consider that it would solve the street-lighting problem. There is no doubt, even now, that on the score of efficiency, i.e., light produced per unit of electrical energy, the arc lamp is almost unapproachable, but the efficiency is, unfortunately, in most cases, obtained at the expense of complicated mechanism involving expensive maintenance and the need of frequent cleaning and recarboning. The light itself, too, even with the modern improvements in arc lamps, is apt to be unsteady and to fluctuate with impurities in the carbons. Nevertheless, in the early 1890's and onwards to about 1908-9, many considerable installations of arc lighting were in evidence in London streets, and, even now, in certain parts of the City, a very effective system of arc lighting is in daily use. From what is said below as to the adjuncts now available for controlling and directing the light sources, it will be obvious that more modern lighting methods are available with reasonably good efficiency, and without many of the drawbacks of the arc lamp.

At a somewhat later stage, the ordinary domestic carbon filament lamp was used in side roads and similar thoroughfares as a competitor to the then only available street light agent, viz., the gas "fish-tailed" burner. The introduction of the incandescent mantle by the Gas Industry rendered the electric carbon lamp no longer acceptable.

While on this subject, and keeping in mind, too, as much as possible, the need to avoid controversy, I think a few words of comment on the gratitude which each of the two competitors should show to the other as being the source of inspiration, may not be out of place. It is a most peculiar and interesting feature of all modern inventions, that they seem to follow and be developed only when some special call arises due to apparatus being required to fill some special need.

This fact can be seen in many phases of modern machinery, etc. The high-pressure steam boiler was not developed, or indeed thought of, until an engine was invented needing high pressure steam. A very light power unit, such as the modern petrol airplane engine, only became available when the airplane designers assured the engineers that without such a very powerful but light unit, flying was impossible; but, strangely enough, practically as soon as the need arises, the inventive mind of man gets to work and produces what is called for. All of you who are electrical engineers will know that this history of inventive development is most marked in electrical work, and it is rarely that an invention stands still because the parts it needs for effective use are not forthcoming. In my opinion, the electrical industry and its great rival, have been to each other most effective spurs to invention.

The introduction of the electric lamp of the simple carbon filament type seemed to threaten its earlier rival very seriously. The Welsbach mantle reversed this. Electricity as a light source seemed to be in the doldrums. The "Tantalum" and "Tungsten" lamps altered this position, and these, too, were followed by improvements in mantles, such as those of the inverted type, which could compete satisfactorily with the older invention. The electric inventor followed with gas-filled lamps, these being counteracted to a large extent by the invention and development of high-pressure gas lighting. This led, in its turn, to very great improvements in the gas-filled "Tungsten" lamp, particularly in the higher wattages, followed by the most recent instance of electric lights, viz., the mercury and sodium discharge lamps. All this interlude must be regarded as a semi-philosophical commentary on the inventive ingenuity of the lighting engineer.

Reverting to the history of the growth of lighting in London, I would remind you of various installations involving the use of the "Jablochkoff" candle used in 1878, and the Nernst Lamp. I am able to include some reproductions of old prints illustrating the lighting of the roads with these earlier methods. For a great number of years, however, as hinted at above, the arc lamp, particularly in the form of the flame arc lamp introduced about 1905, seemed likely to hold the field, notwithstanding the above-mentioned drawbacks, and it is really only within the past seven or eight years that the great improvements in effective lamp and candle-power maintenance throughout the life of modern tungsten filament lamps, fitted into globes with inert gas, have led to the gradual supersession of the arc lamp by the large wattage filament type.

Fig. 4. Electric Lighting near the Royal Exchange, London. about the year 1891.

Improvements in Filament Lamps.

The great improvements in the effective lamp and candle-power maintenance throughout the life of

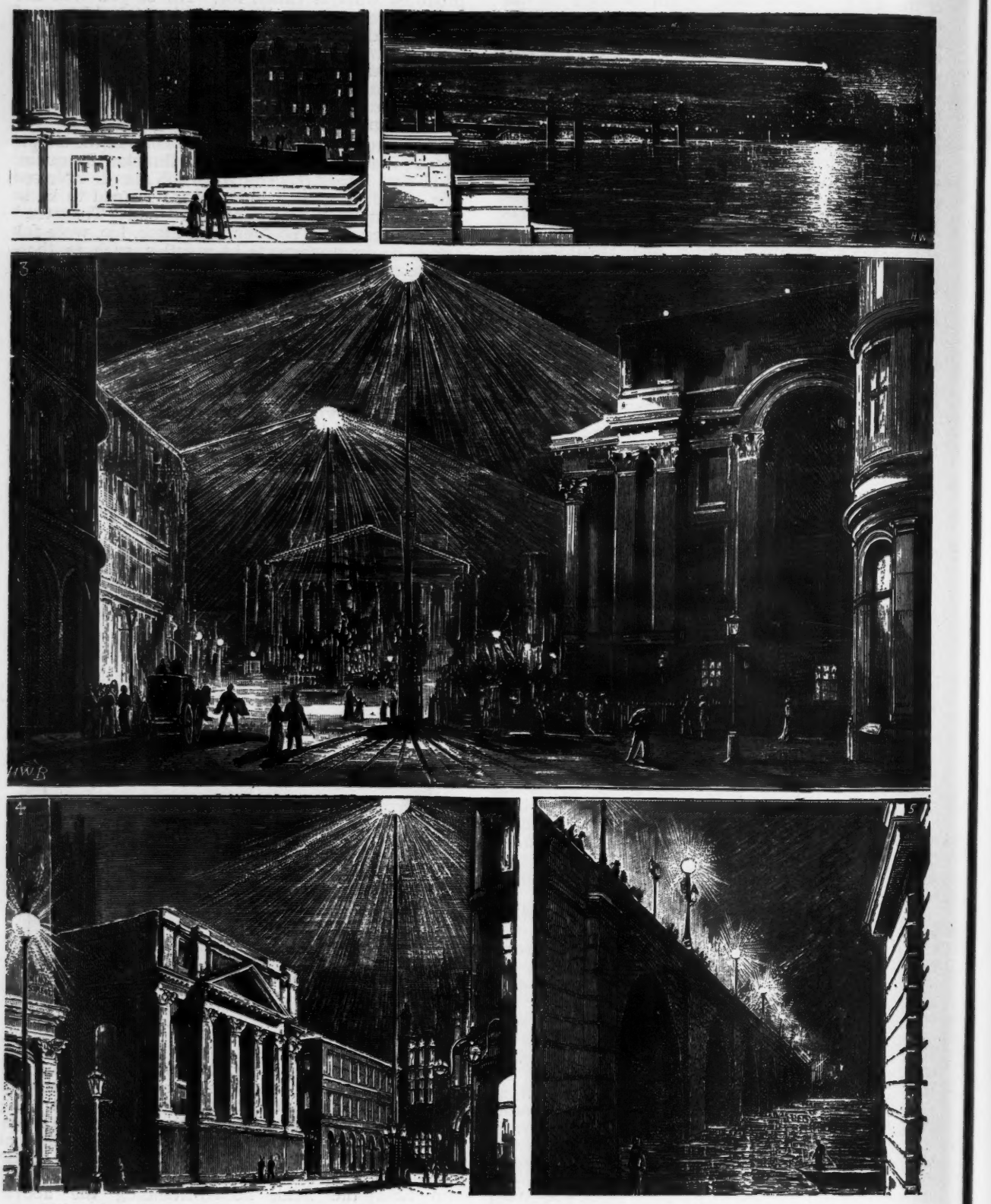


Fig. 5. Another Series of Old Prints showing early electric lighting with arc lamps in London.

modern tungsten filament lamps is illustrated in Figs. 6 and 7, and as these improvements have gone hand in hand with an equally progressive reduction in the average cost of electric current, the earlier advantages of the arc lamp have become less marked. The diagram shown on Fig. 8 gives an indication of the reduction in the average cost of current.

A good deal of information on these improvements has been given in previous papers read before various societies. I do not think, therefore, that I need give further statistics on the subject, but confine myself to assuring readers and hearers that there is every indication that those progressive improvements are continuing.

It is, however, of considerable interest to observe that methods of street lighting have been almost stationary for the past few years, apart from the improvements in lanterns and reflector elements to

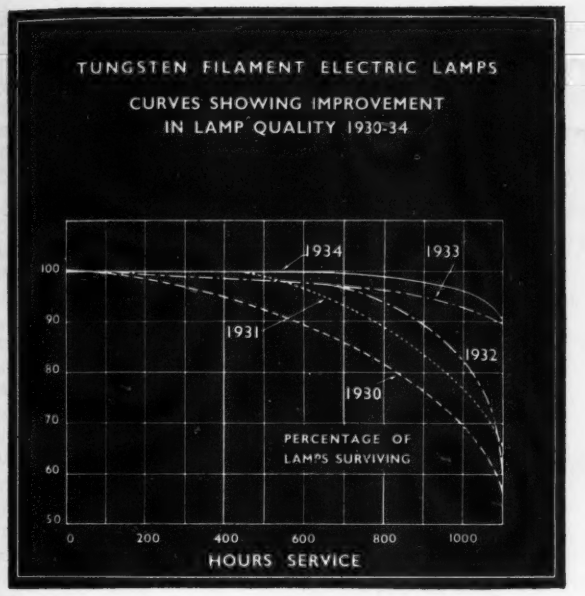


Fig. 6. Showing progressive improvement in life of electric (filament) lamps (1930-1934).

Fig. 8. Reduction in cost of Electricity for Public Lighting (1920—1933).

which reference has previously been made. These, although leading to considerable improvement in efficiency, are not in themselves epoch-making, and would not, I think, influence the prospects of electric street lighting so favourably as the latest development I propose now to deal with. This is, of course, the production during the past two or three years of the electric discharge lamp in various forms. It is, in my opinion, the greatest single step forward in lamp technique that the present generation has witnessed.

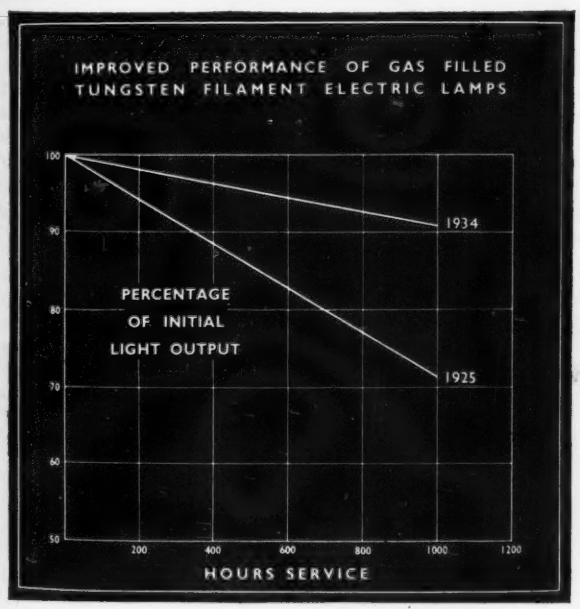


Fig. 7. Showing improvement in candle-power maintenance of electric filament lamps in 1934, as compared with 1925.

The Electric Discharge Lamp.

The system was at first introduced in the form of the sodium discharge lamp, and the earliest installation near London was in Croydon in the Purley Way, installed in 1932, although a certain amount of such lighting had somewhat earlier been in use in Holland. More recently, however, at least so far as London is concerned, the mercury lamp has been the more successful.

The increase in quantity of light per unit of electricity given by the new lamp, as is now comparatively well known, is two to three times that of the filament lamp hitherto used as standard for lighting purposes, and this increase is illustrated in Fig. 4, which shows the comparative quantity of light from various light sources. This also indicates certain

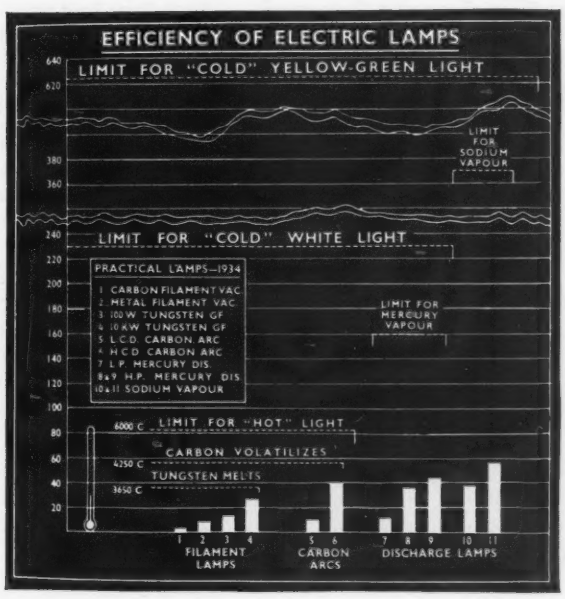


Fig. 9. Comparative Efficiency of Various Electric Illuminants.

theoretical limits of efficiency from these light sources and shows that whereas there is a distinct limiting possibility to any source of light which depends upon the temperature of an element to give its light, in the case of the discharge lamp, where the heating of an element is not the determining factor, the future possibilities are much greater. It is obvious, I think, that a lamp such as the Tungsten or other filament bulb, must reach its maximum efficiency when some

heat limit of temperature is attained, and the table is drawn up on the basic efficiency figure of 85, representing a lamp working at the temperature of the sun. The possible limit, on the other hand, of the new electric discharge lamp is far higher.

The rate at which these new lamps are being adopted in Great Britain is strikingly shown in Fig. 10,

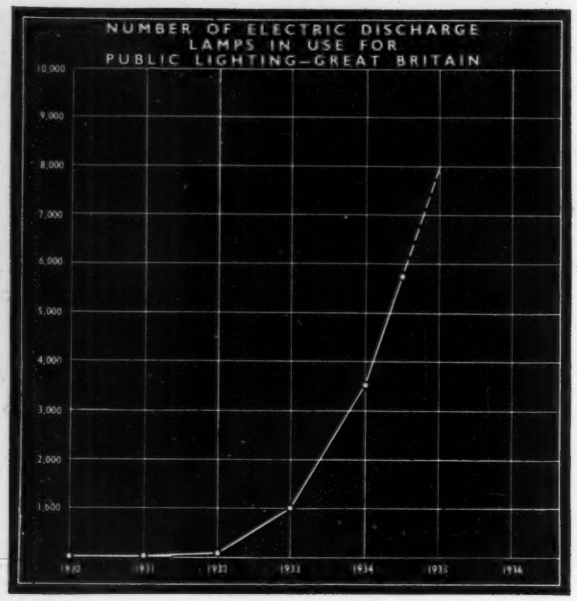


Fig. 10. Illuminating development in use of electric discharge lamps for public lighting.

and London can claim a very large proportion of this increase. During the past three years, I have had a good deal of experience in installing and equipping lamps of this type in about fifteen miles of main roads in Lewisham and Greenwich. I have thus had unique opportunities of finding the advantages and the defects inherent in the system. I believe the first installation in or adjoining London of the new system of mercury discharge lamps was put up in the road adjoining the G.E.C. research laboratories at Wembley. This was followed early in 1932 by an installation in the main road at Wembley by the North Metropolitan Electric Supply Company, the installation incorporating not only an improved lamp, but certain lantern improvements.

I was, towards the end of 1932, negotiating for certain street lighting in Lewisham, and, after careful investigation, decided to recommend the new system. In July, 1933, a sample installation of eight lamps was erected in one of the Lewisham main tramway roads. This was effected with a newly designed lantern, which has since become somewhat historic, and associated with the name of the area in which it was first used. I believe I am correct in stating that the Lewisham installation is the first in the denser parts of London.

The Colour Problem.

It met, at first, very considerable criticism from local residents and others, based on the colour of the light. Looking back over the past two years, the violence of the criticism seems, in a measure, to be somewhat inexplicable, but I can assure my hearers that the local agitation on the subject was very strong, leading to violent acrimonious correspondence in the local Press. The chief point stressed, of course, was the effect of the light on the human complexion, and secondly, upon any shop goods with a preponderance of red in their colour constituency, and the aid of the ladies of the Borough, who were considered to be vitally interested in the preservation of a more or less ruddy complexion, was called in to help the campaign. It is now common knowledge that the experiment in Lewisham, on the whole, proved quite successful. My Company has since installed about 276 lamps in the main roads in the borough, and are now under contract to supply a further 110. Two hundred lamps have also been installed by my Company in the adjoining Borough of Greenwich.

Now, why has this colour criticism proved in practice of little importance? The subject is one which is of considerable interest, and my experience may be of service to engineers in various parts of England who may be dealing with the subject of street lighting. It is an undoubted fact that since the permanent lighting in the main roads has been installed, and the violence of the agitation in the early days has died down, there has been practically no criticism of the colour effects, and I am betraying no secret in giving my assurance that the Borough officials have had no specific complaint from ratepayers. The reason is, I think, a two-fold one. Firstly, the other advantages of the light in the way of greatly increased visibility and brightness of the road surface, and, in consequence, safety of the roads, have more than counter-balanced the colour difficulty, and, secondly, use being second nature, road users have become acclimatised to the new colour, and, in fact, fail to notice it.

My view on this subject is that we are, to a much greater extent than is commonly appreciated, creatures of fashion and usage. Our life in evening and night hours has been passed in artificial light of a red-yellow colour, which by no means gives truly natural renderings to flesh or other colours. A sudden change of this evening environment with a light giving other colour rendering naturally causes some shock, but if the position had been reversed, and for the past few hundred years we had lived in an evening artificial colour which, while not giving a sunlight rendering of colours gave a reasonably good imitation of moonlight colours (which at any rate are "natural" to the same extent that an evening moonlight colour is natural) and had suddenly been changed into a red-yellow artificial light, the same or similar criticism of "unnaturalness" would have resulted! Moonlight effect, however, is, I venture to think, quite as "natural" as any red-yellow artificial light we have yet experienced. My belief on this matter has been considerably strengthened of late by the fact that in the section of the new lighting installed by the South London Electric Supply Corporation on the parapet of the River Thames for the L.C.C., and which, for a considerable distance lights a pedestrian thoroughfare, and is therefore used only by promenaders, no complaint has been received by the Council or the Supply Company of any objectionable colour difficulties.

Influence of Colour on Visibility.

My own experience, too, of colour is that the natural moonlight colour has in itself certain qualities which give better visibility effects. With the same standard of foot-candle illumination, I have formed the opinion that objects stand out with the bluer light in a more marked way than they do in the red-yellow of the older standard method of lighting.

Some of this effect is, of course, due to the dispersive nature of the lighting caused by the special lanterns which have been used to the greatest extent with mercury lamps, but a proportion of the merit of this feature must, I think, be awarded to the colour rendering. I have discussed, for instance, with taxi-drivers, the general effect of driving through roadways illuminated by the standard electric filament lamp and then passing into one such as the Albert Embankment, lighted with the newer method. The

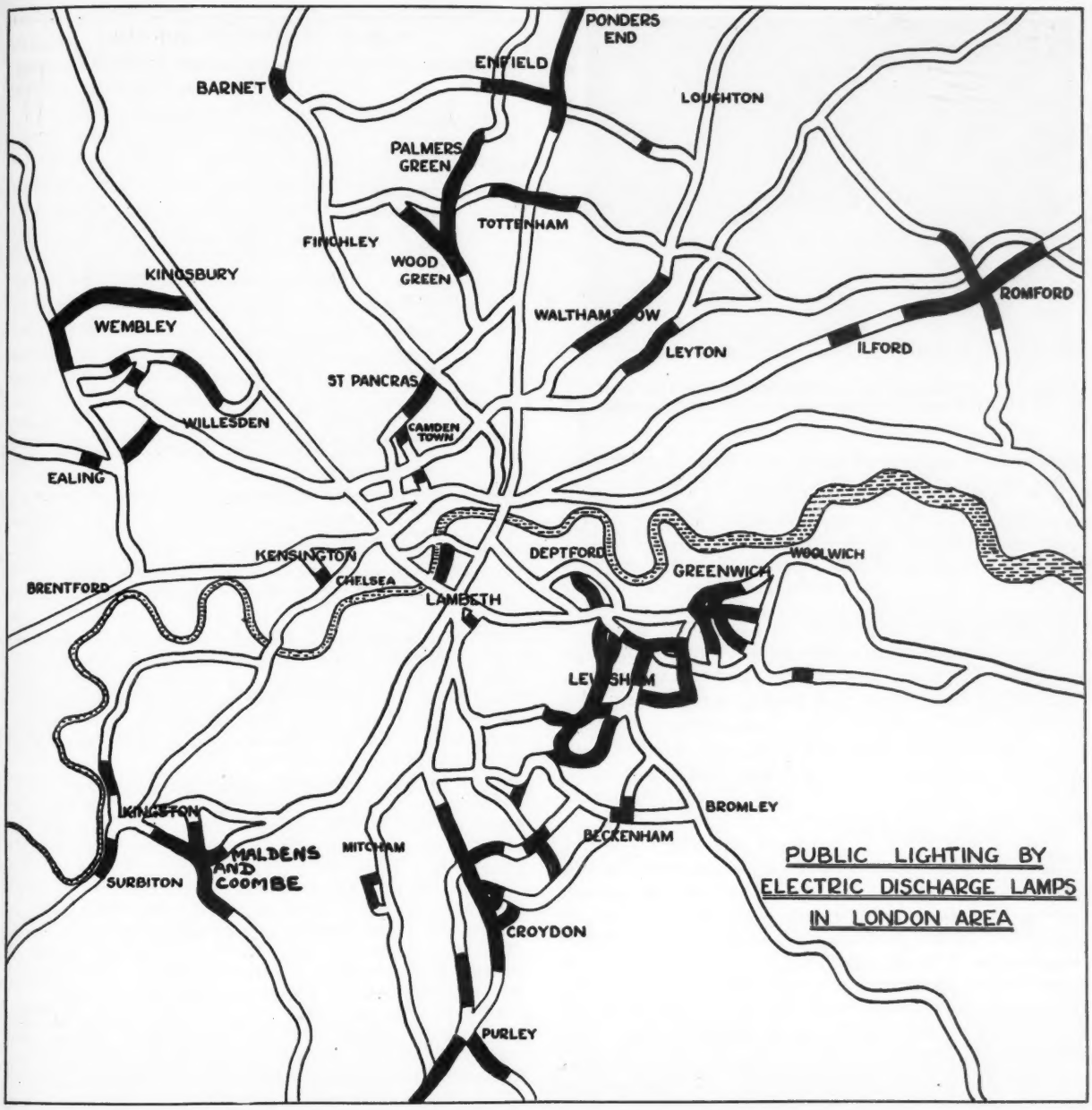


Fig. 11. Showing streets lighted by electric discharge lamps in the London Area.

Fig. 12. The L.C.C. Parapet, Lambeth. Lighting by 250 watt. HPMV Electric Discharge Lamps in original parapet fittings.

Fig. 13. Part of the Lambeth Palace Road. Lighting by 400 watt. HPMV Electric Discharge Lamps in Refractor Lanterns.

Fig. 14. A section of the Lewisham installation of 14 miles of 400 HPMV Electric Discharge Lamps in Refractor Lanterns.

consensus of opinion of these men is, as they put it, "that the blue light gives a brighter road illumination." Technicians know that this is, in a great measure, not so, for in certain cases the foot-candle illumination of the mercury lamp is actually considerably less than that afforded by the filament lamps.

PUBLIC LIGHTING IN EUROPE.

PERCENTAGE OF ELECTRIC LAMPS OUT OF TOTAL NUMBER OF STREET LAMPS

Town	1929	1932
BERLIN	20	19
BRUSSELS	5	8
BUDAPEST	63	67
THE HAGUE	100	100
HELSINGFORS	59	67
COPENHAGEN	51	62
LONDON	45*	50
MADRID	16*	19
OSLO	100	100
PARIS	22	32
PRAGUE	57	62
ROME	100	100
STOCKHOLM	72	83
WARSAW	49	54
VIENNA	55	65
ZURICH	66	86
Average	55%	66%

NOTE 1.—An increase in the proportion of electric lighting in all towns except the one per cent. drop in Berlin, due to bad financial conditions preventing progress.

NOTE 2.—Since 1932 the electric discharge lamp has increased the rate of electrification.

NOTE 3.—* Estimated figures.

Fig. 15. Illustrating the development of electric lighting in London as compared with other European capitals.

Improvements in Efficiency.

Before passing on to a new aspect, I might perhaps call your attention to the improvement which has been effected in these new lamps, even during the comparatively short time they have been on the market. The original lamp, which was of the 400 watt size, had an initial efficiency of 40 lumens per watt, and the average output in lumens during 1,500 hours of life was 31, or 77½ per cent. of the initial.

The modern lamp of the same size has an initial output in lumens per watt of 45 (an increase of 12½ per cent. on the first lamps). The average output during life is 37 lumens per watt, an increase of practically 20 per cent. on the earlier average. These figures are, I think, encouraging at such an early stage in the history of the new departure, and are reasonably comparable with the performance of the much more established Tungsten filament lamp. So far as actual burning hours are concerned, and leaving the question of "falling away" of light output as of secondary importance, the life of the mercury discharge lamp is very greatly in excess of that of the filament lamp, and I have had discharge lamps burning in Lewisham for well over 2,600 hours.

It will be seen I am somewhat of an enthusiast in regard to this modern development of street lighting, but I must at the same time confess that there are one or two features in which it is inferior to the standard electric illumination, and certain other features in which it has peculiar weaknesses of its own.

As an example, there is the fact that it takes from five to eight minutes to attain its full brilliancy after being switched into commission, whereas, of course, the standard lamp gives its full output immediately on being switched on. This characteristic does not cause any serious practical difficulty, as the switching-on time can be controlled to compensate for it, but it certainly has caused certain minor criticisms by visitors who are not familiar with the system.

Another point which, I think, should be mentioned, is the difficulty of determining when a lamp has permanently failed, i.e., when it has, to use the old phraseology, "burnt-out." With an ordinary filament lamp, the breaking of the filament is obviously a definite indication of failure, but there is no such visible indication in the discharge lamp. In the installations under my charge in Lewisham, Greenwich, and Lambeth, I have, after consultation with the makers, adopted a small relay, which automatically switches a spare or pilot lamp into commission when the current fails to pass through the discharge tube. This relay is also a valuable insurance against temporary extinctions of the lamp caused, say, by low voltage, as contrasted with a definite cessation or interruption in the supply.

Such drops in pressure, caused by surges, are quite likely to be a feature for some considerable time, at least, on electric supply networks, especially as the inter-connection caused by the "Grid" practically puts a very large area into one huge network, and thus, any untoward incident occurring over a large area may set up a surge likely to affect the lighting networks. The insurance precaution which I have adopted and found very successful, seems to be of considerable value for street lighting purposes, if perhaps unnecessary for general industrial use.

In such a paper as this it seems only fair to indicate both the drawbacks and the advantages of the new lamp. It will be seen that the latter are only two in number, unless the initial first cost of the lamp is also to be considered a disadvantage! This, however, can only be determined by reference to the total light output obtained per lamp unit, which, as I have previously mentioned, is two to three times that of standard lighting. At any rate, the drawbacks have weighed very lightly in the scales compared with the advantages, and the remarkable growth in the number of lamps in use is a striking testimony of this fact.

Lanterns.

Hand in hand with the improvement in lamp design there has been improvement in the lanterns which accommodate them. This improvement has, strangely enough, been more marked since the advent of the electric discharge lamp, and is, perhaps, another illustration of the fact referred to in the earlier part of this article of the need for any new development always resulting very quickly in its fulfilment.

Thus, the installation of relatively high capacity (1,000 watt) Tungsten lamps in Westminster in 1923, brought to light the fact that when lamps were enclosed in confined spaces the life of the lamp was greatly reduced, and it was comparatively inefficient in its light distribution. Special prismatic refractors were therefore installed in the lanterns to control

the flux of light, but here, too, the great heat and the confined space affected very adversely the life of these refractors, and lamp failures continued to be a troublesome factor.

The next development was the production of a special lantern with ventilators, which actually extracted the air at a very high rate, so that the temperature rise inside the lantern was very much reduced. Lamp and refractor troubles were very much lessened, and the standard average life of 1,000 hours burning could be expected with confidence. The ventilation method, however, had its own weakness, for it allowed dust and dirt to be drawn into the lantern, resulting in additional cleaning costs; and research resulted in improvements in the lamp filament, the method of fixing the cap, the glass of the bulb, etc., being made, these making it possible to return to the original air-tight lantern without undue trouble. Modern lanterns, therefore, more particularly those used for the electrical discharge lamp, are practically air-tight, and the cleaning needed has been brought to a very small amount

The next step in the improvement of lanterns was associated with the design of the dispersive refractors, the earlier ones, giving an "all-round" dispersion, being found inefficient from the street lighting point of view. As the technique of these refractors and reflectors improved it was possible to concentrate a greater percentage of the light in any desired direction. Naturally, in the early stages, the direction was that indicated by the B.S.I. specification test points. It was soon found, however, that the high magnifications given to these earlier directive lanterns, while giving a good foot-candle reading at the midway test point, did not give good road appearance, but caused an apparent darkness at and slightly beyond each post, with bright areas on the near side of the unit.

It was remarked earlier in this article that an even and bright road appearance is what should be aimed at for street lighting. Experimental work in this field has ultimately resulted in refractors to-day being designed to give slightly lower peak candle-power than was at first adopted, but with a distinct improvement in the road surface appearance. It has been found that the most even brightness is produced on the road surface by a broad distribution of candle-power, instead of concentrating in the direction of B.S.I. test points.

Such a principle naturally allows a much greater latitude as regards spacing, and the installations embodying the gaseous discharge lamp with which I have been associated have been designed, primarily, with a view to giving regular road surface brightness, and, secondly, to give very wide angle dispersion, so as to obtain a good "silhouette" with vertical objects on the roadway.

This method has been aided by arranging that the light output comes from quite a large surface of glass, in itself comparatively lightly illuminated—a distinct departure from the method quite popular four or five years ago of installing small bright areas as a source of supply. I myself installed a main street in Lewisham with filament lamps with reflecting mirrors and a comparatively small light source area, and had to agree that the public criticism of the light as being "glaring," was, to a great extent, justified. I may add, too, that this very factor kept back the progress of electric lighting in my area considerably, and it was the advent of the new gaseous discharge lamp with its non-glaring lantern which saved the situation. On the question of glare a test of some considerable interest was made by gauging the ability of an observer to pick up a coin after staring at various light sources, and it was found that with the electric discharge lamp in the Lewisham type lantern, such an object could be picked up much more quickly than in the case of other light sources in the neighbourhood.

While dealing with the question of lanterns, I may add that there is undoubtedly, even now, on the part of many of the public, a demand for a very bright light source. Such a demand can now be very readily met, and a new form of refractor for use with electric discharge has been designed with this purpose in view. It has all the directional features of the earlier lantern, and is considerably cheaper to install, though, in my opinion, it has perhaps the drawback of a rather brighter operating surface of smaller area, which is to be condemned if carried to excess. This is, however, quite a new departure, having only been in use with gaseous discharge lamps during the past few months.

Mounting.

Another factor in street lighting in London where the fashion has altered is shown in the steady increase in the average mounting height of electric lamps, and this, naturally, contributes to the freedom from glare referred to above.

The majority of electric discharge lamps are mounted at twenty-five feet above the carriageway with remarkably good results. The use of refractor units from which the light thrown on the roadway reaches it at a comparatively small angle aids the silhouette effect which is so desirable to road users. The comparative high mounting, too, enables good and regular road lighting to be obtained without the objectionable and, in my opinion, inartistic method of using centrally suspended lamps, which are only desirable in exceedingly narrow streets (such as Cannon-street or other similar thoroughfares).

I do not think there can be much criticism of the doctrine that, other things being equal, the less obtrusive a street-lighting installation is in the daylight hours the nearer approach to the ideal it represents. Surely, therefore, the daylight appearance of a street-lighting installation should be taken into account when the respective merits of the methods are reviewed. Even on curved roads, admittedly difficult to deal with readily, electric lamps with special directive refractors mounted on lamp standards set on the outer curve of the road, enable regular lighting to be obtained without the unsightliness and the additional cost of double poles and suspended lamps.

A good deal of praise on the research work of this phase of the matter must, I think, go to the Wembley Laboratories of the General Electric Company, who have carried out a very great number of experiments, many of which I have viewed with interest, on the question of road brightness and the cheapest and most efficient way of obtaining it. From the practical point of view the main principles I regard as desirable are attained by:—

(1) A good mounting height.

(2) Side mounting in staggered formation rather than central suspension.

(3) Selected positions of the posts on curved roads.

(4) The use of lanterns giving a broad beam with maximum candle-power directions much nearer the horizontal than were formerly used.

The lighting effects due to the improvements in technique in lantern design and mounting methods, will be appreciated on the actual roadways which I

Fig. 14. A section of the Lewisham installation of 14 miles of 400 HPMV Electric Discharge Lamps in Refractor Lanterns.

consensus of opinion of these men is, as they put it, "that the blue light gives a brighter road illumination." Technicians know that this is, in a great measure, not so, for in certain cases the foot-candle illumination of the mercury lamp is actually considerably less than that afforded by the filament lamps.

Improvements in Efficiency.

Before passing on to a new aspect, I might perhaps call your attention to the improvement which has been effected in these new lamps, even during the comparatively short time they have been on the market. The original lamp, which was of the 400 watt size, had an initial efficiency of 40 lumens per watt, and the average output in lumens during 1,500 hours of life was 31, or 77½ per cent. of the initial.

The modern lamp of the same size has an initial output in lumens per watt of 45 (an increase of 12½ per cent. on the first lamps). The average output during life is 37 lumens per watt, an increase of practically 20 per cent. on the earlier average. These figures are, I think, encouraging at such an early stage in the history of the new departure, and are reasonably comparable with the performance of the much more established Tungsten filament lamp. So far as actual burning hours are concerned, and leaving the question of "falling away" of light output as of secondary importance, the life of the mercury discharge lamp is very greatly in excess of that of the filament lamp, and I have had discharge lamps burning in Lewisham for well over 2,600 hours.

It will be seen I am somewhat of an enthusiast in regard to this modern development of street lighting, but I must at the same time confess that there are one or two features in which it is inferior to the standard electric illumination, and certain other features in which it has peculiar weaknesses of its own.

As an example, there is the fact that it takes from five to eight minutes to attain its full brilliancy after being switched into commission, whereas, of course, the standard lamp gives its full output immediately on being switched on. This characteristic does not cause any serious practical difficulty, as the switching-on time can be controlled to compensate for it, but it certainly has caused certain minor criticisms by visitors who are not familiar with the system.

Another point which, I think, should be mentioned, is the difficulty of determining when a lamp has permanently failed, i.e., when it has, to use the old phraseology, "burnt-out." With an ordinary filament lamp, the breaking of the filament is obviously a definite indication of failure, but there is no such visible indication in the discharge lamp. In the installations under my charge in Lewisham, Greenwich, and Lambeth, I have, after consultation with the makers,

PUBLIC LIGHTING IN EUROPE.

PERCENTAGE OF ELECTRIC LAMPS OUT OF TOTAL NUMBER OF STREET LAMPS

Town	1929	1932
BERLIN	20	19
BRUSSELS	5	8
BUDAPEST	63	67
THE HAGUE	100	100
HELSINGFORS	59	67
COPENHAGEN	51	62
LONDON	45*	50
MADRID	16*	19
OSLO	100	100
PARIS	22	32
PRAGUE	57	62
ROME	100	100
STOCKHOLM	72	83
WARSAW	49	54
VIENNA	55	65
ZURICH	66	86
Average ...	55%	66%

NOTE 1.—An increase in the proportion of electric lighting in all towns except the one per cent. drop in Berlin, due to bad financial conditions preventing progress.

NOTE 2.—Since 1932 the electric discharge lamp has increased the rate of electrification.

NOTE 3.—* Estimated figures.

Fig. 15. Illustrating the development of electric lighting in London as compared with other European capitals.

adopted a small relay, which automatically switches a spare or pilot lamp into commission when the current fails to pass through the discharge tube. This relay is also a valuable insurance against temporary extinctions of the lamp caused, say, by low voltage, as contrasted with a definite cessation or interruption in the supply.

Such drops in pressure, caused by surges, are quite likely to be a feature for some considerable time, at least, on electric supply networks, especially as the inter-connection caused by the "Grid" practically puts a very large area into one huge network, and thus, any untoward incident occurring over a large area may set up a surge likely to affect the lighting networks. The insurance precaution which I have adopted and found very successful, seems to be of considerable value for street lighting purposes, if perhaps unnecessary for general industrial use.

In such a paper as this it seems only fair to indicate both the drawbacks and the advantages of the new lamp. It will be seen that the latter are only two in number, unless the initial first cost of the lamp is also to be considered a disadvantage! This, however, can only be determined by reference to the total light output obtained per lamp unit, which, as I have previously mentioned, is two to three times that of standard lighting. At any rate, the drawbacks have weighed very lightly in the scales compared with the advantages, and the remarkable growth in the number of lamps in use is a striking testimony of this fact.

Lanterns.

Hand in hand with the improvement in lamp design there has been improvement in the lanterns which accommodate them. This improvement has, strangely enough, been more marked since the advent of the electric discharge lamp, and is, perhaps, another illustration of the fact referred to in the earlier part of this article of the need for any new development always resulting very quickly in its fulfilment.

Thus, the installation of relatively high capacity (1,000 watt) Tungsten lamps in Westminster in 1923, brought to light the fact that when lamps were enclosed in confined spaces the life of the lamp was greatly reduced, and it was comparatively inefficient in its light distribution. Special prismatic refractors were therefore installed in the lanterns to control

the flux of light, but here, too, the great heat and the confined space affected very adversely the life of these refractors, and lamp failures continued to be a troublesome factor.

The next development was the production of a special lantern with ventilators, which actually extracted the air at a very high rate, so that the temperature rise inside the lantern was very much reduced. Lamp and refractor troubles were very much lessened, and the standard average life of 1,000 hours burning could be expected with confidence. The ventilation method, however, had its own weakness, for it allowed dust and dirt to be drawn into the lantern, resulting in additional cleaning costs; and research resulted in improvements in the lamp filament, the method of fixing the cap, the glass of the bulb, etc., being made, these making it possible to return to the original air-tight lantern without undue trouble. Modern lanterns, therefore, more particularly those used for the electrical discharge lamp, are practically air-tight, and the cleaning needed has been brought to a very small amount

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believe many of you are to inspect during the Conference; but as the tour is of necessity restricted in its scope, I have collected a few photographs of various sections of lighting in the London area to illustrate points of interest.

A Comparison with other European Capitals.

I have said in passing that the progress up to date in electric street-lighting in London has been very marked, and that it has been aided very considerably in recent years by the new electric discharge lamp. In this respect, Great Britain, and the London area in particular, has advanced considerably further than either the Continent or America, although possibly the extent of the electric street-lighting in London as a whole is not up to the average of European capitals. Fig. 15 shows the percentage of electrified lamp-posts in the different capitals of Europe. Unfortunately, there were no reliable figures for London in 1929, but several interesting facts stand out. There has been an increase in the proportion of electric units used in every capital, except Berlin, where progress has been difficult, owing presumably to economic and political conditions. Of the sixteen capitals shown, eleven had in 1932 a greater proportion of electric lamps than London, and only four a lower proportion. In London, therefore, the conditions are still very far removed from those in such cities as The Hague, Oslo, and Rome, where the streets are lighted entirely by electricity.

The Future.

Finally, what of the future? I think we may, with confidence, say that this is exceedingly bright and that its brilliancy grows daily. In addition to the improvement in the efficiency of the source and the possibility of still further improvement, the advent and extension of the "Grid" and generally improved methods of electrical distribution will undoubtedly lead to the cheapening of electrical energy with an inevitable reaction in the cost of public lighting.

The greater uniformity which is likely to be sought by Committees of the Ministry of Transport and others will, I venture to think, lead to a grade of lighting on higher standards than are at present adopted.

I do not see how any radical alteration in the method of street lighting from that described above can be expected, unless some of the ingenious schemes of town life mentioned by Mr. H. G. Wells in his scientific novels come to pass. It may be recollected that in at least one of these he visualises all traffic thoroughfares being roofed in, in which case, of course, ideal conditions for street lighting through controlled and hidden sources would be practicable, and even the principle of staggered lanterns with refractors would be out of date.

My sincere thanks should be expressed to the General Electric Company and its staff for the very valuable assistance they have given to me in preparing this paper, and for the loan of slides and illustrations. I have also received valuable data from the British Thomson-Houston Company.

DISCUSSION

Mr. C. C. Paterson (Research Laboratories, General Electric Company) remarked that the figures for the number of licensed vehicles given in the paper, if brought up to date, would show a very considerable increase, and added that the flattening out of the curve towards the end, as shown in the paper, was an echo of the years of depression. Speaking generally on the improvement of lighting of streets and its effect upon accidents, Mr. Paterson expressed the view that the motorist would always drive as fast as the road permitted him, and that the speed of motor vehicles would increase with improved lighting. His own view was that until street lighting gave the same visibility as existed under daylight conditions we could not expect any great diminution in accidents.

Mr. C. Harper (Assistant Borough Engineer, Barking) asked for a little enlightenment with regard to mounting height for street lamps. Judging from the slides that had been shown, it seemed to be 50 feet or 60 feet in the old days. The author seemed to regard brilliant advertising and shop lighting as leading to safer conditions on the roads, but he felt that that required serious qualification—because when there was elaborate shop lighting there was a tendency for the local authority to regard their liability in relation to street lighting as ceasing, which was surely a dangerous position! Moreover, motorists were generally agreed that brilliant coloured lights used for advertising purposes coming into the same line of vision as traffic signal lights were highly inconvenient.

Mr. S. J. Patmore (General Electric Company), speaking with regard to criticisms of the colour of electric discharge lamps, said experience showed that this bogey of colour was soon buried after an installation had been running for only a few weeks. It was really only a matter of unfamiliarity and natural conservatism to change. In connection with the figures in the paper relating to increases in the number of vehicles using the roads, could the author give some information regarding the appreciation of road passenger transport authorities of the benefits of the lighting schemes described in the paper; and also could he say whether these schemes had in any way increased the volume of passenger traffic carried by those authorities. Finally, Mr. Patmore suggested that it might be desirable for the Association of Public Lighting Engineers to invite representatives of the Municipal Tramways and Transport Association and the Tramways, Light Railways and Transport Association to these Conferences, because these organisations represented the largest users of the roads in the districts through which they operated, and co-operation could not fail to be of the greatest advantage.

Mr. A. S. Parsons (Reading) referred to the surge-protection device which the author had in use. He himself had not had any difficulties with the electric discharge lamps due to surges. The lamps would take a 10 per cent. drop, and he hardly imagined that there would be so large a drop, which amounted to 20 volts. on a 200-volt system, on any electric supply system in the country.

Speaking on the question of road brightness, he said he had carried out experiments on the original test stretch of street in Reading, which had a surface of tar macadam. The 200-watt lamps, fitted with the mirror type of reflector, were quite satisfactory, although the road surface was not. In a subsequent installation the road was concrete, and it was found that by increasing the height of the lanterns by 2 ft. 6 in. it was possible to cut down the wattage to 150, and considerably increase the road brightness. It was also possible to increase the spacing by 25 ft., all of which reduced the cost. Referring to the fact that the author had had lamps burning 2,600 hours, Mr. Parsons said he had similar lamps which had been burning for 3,400 hours, and were still in good condition without any increase in current consumption and very little falling off in the light output. Although some objection had been taken to the colour when the

electric discharge lamps were first installed, this died down after about three weeks. Whilst originally there had been talk of a petition to remove them, eventually there was actually a petition asking for the same type of lamp to be used all over the town. Finally, Mr. Parsons supported the plea made previously during the Conference for some standard method of taking photographs of street-lighting installations for comparative purposes.

Mr. W. J. JONES (E.L.M.A.), remarking that the author had dealt with street lighting in London in an extraordinary romantic manner, said that, unfortunately, Londoners suffered from a legacy of street lighting which carried with it certain disadvantages. For example, the multiplicity of interests led to lack of consistency in the degree of lighting provided in various parts. In this connection he referred to the instance of the North Circular Road, on which over a distance of some fifteen miles there were no fewer than twenty-seven systems of lighting, ranging from high-mounted gas lamps, low-mounted gas lamps, high-mounted electric lamps, low mounted electric lamps, to no lighting whatsoever. In the same way, he called attention to the great variety of degrees of street illumination to be seen on a journey from the Hotel Metropole, where the Conference was being held, to Golders Green. It was possible, he said, to distinguish the boundaries of each local authority by the nature of the lighting provided. At the same time, he emphasised the point that in London it was possible to see some of the best street lighting in the world, although admittedly there might also be some specimens of the worst!

Commenting upon the fact that there had been a gradual increase in the amount of illumination available for street lighting, Mr. Jones said it was not always realised that by doubling the brightness on the road surface there was an increase of 30 per cent. in the speed of seeing. He emphasised the point that it was no good improving a street-lighting installation by 10 or 15 per cent. in illumination, because that did not give a result which was worth while It was necessary, at least, to double the illumination, and for this reason he urged those contemplating street-lighting changes to bear this fact in mind. In his view, continued Mr. Jones, the paramount reason why the electric discharge lamp was so successful was that it automatically permitted an increment in lighting values of the order of 200 per cent., or 250 per cent., and this in turn brought about an increment of 50 per cent. in speed of seeing.

Councillor F. P. CROOK (Chairman, Street Lighting Committee, Wembley) pointed out that in Wembley there were now seven and a half miles of streets equipped with the most modern street electric lighting equipment, whilst another mile was being dealt with. When this was completed, however, he felt that the Wembley Council would have seriously to consider the position from the point of view of cost, which had been one of the causes for lack of development in street lighting. He, therefore, expressed the hope that those responsible for providing this type of equipment would make a really serious attempt to deal with the question of cost, because in one part of London the lighting was produced at a certain price and in another part the price was quite different. If that condition continued local authorities in general, and Wembley in particular, would have seriously to consider their position.

Mr. J. K. BRYDGES (Borough Electrical Engineer, Eastbourne), referring to centrally suspended lamps, said that with this type of lighting there was an inclination for the motor traffic to keep rather to the centre of the road. Therefore it was better to have the lamps staggered and suspended from tall posts on the side walks with ten feet or twelve feet arms so that the lamps were not seen along the centre of the road. When the author referred to the aesthetic point of view in connection with centrally suspended lamps he presumed he referred to appearance during daylight, but surely that was not of much importance. For years there had been overhead trolley tramway systems following the conduit and stud systems of traction, and although objections were raised at the beginning, this form of traction was now universal. Moreover, changes were being made in many places to trolley buses which involved the use of two overhead wires instead of one. Therefore, he did not think there was much in this question of aesthetic appearance. On the question of speed of motor traffic with better lighted roads, surely the majority of such roads were now restricted and motorists were not allowed to travel at more than thirty miles an hour. Finally, on the question of the colour of electric discharge lamps Mr. Brydges said that in Eastbourne they had attempted to overcome this difficulty by incorporating in the same lantern some ordinary gas-filled lamps. For instance, in certain lanterns gas-filled lamps of 500 watts were replaced with one 250 discharge lamp and three 100-watt ordinary gas-filled lamps, making a total of 550 watts, as compared with 500 previously. This had had the effect of modifying what was regarded by some people as the objectionable colour. The efficiency, however, was naturally not so high as would be obtained from electric discharge lamps alone. It would be interesting to hear whether if suitable gases were introduced into the electric discharge lamp with a view to improving the colour, the efficiency of the light produced in such a single unit would be less or more than the efficiency being obtained by the method adopted in Eastbourne.

Mr. JAMES H. CARTMELL (Lighting Superintendent, Preston) briefly described the installation of dual lamps on Fishergate Hill, Preston. This installation, the first of its kind, was installed by the Corporation of Preston Street Lighting Department on July 24, 1935, for the purpose of ascertaining the performance of a new combination light source in practice previous to its commercial release. The lanterns used in the installation consisted of a flashed opal totally enclosed globe approximately twenty inches deep by sixteen inches at its widest point. The installation consisted of six lanterns spaced 140 feet apart, containing the new 500-watt lamp, on one side of the road only and were suspended six feet out into the carriageway at a mounting height of twenty-five feet. The carriageway was surfaced with tarred granite sets. The resultant illumination was of a high order and owing to the low intrinsic brilliance of the light sources specular reflection from the road surface was remarkably low, even when the surface was wet after rain.

Some slides were shown and it was stated that the colour rendering had proved highly satisfactory, and that this effect was well brought out by a series of coloured posters situated along a portion of the west side of the road. The neighbourhood in which this installation was situated was of a residential nature and the installation had evoked favourable comment.

Continuing, Mr. Cartmell said that the 500-watt lamps used for these tests were released for the market on September 2, 1935. They embodied two fundamental improvements over the original form of electric discharge lamp. (1) They did not require choke coils or condensers for their efficient operation; (2) The colour of the light emitted was of a very pleasant nature. The lamps combined a discharge tube and a tungsten filament in one bulb—the tungsten filament being used to control the discharge and of itself providing a correction to the colour of the discharge tube.

Mr. C. A. MASTERMAN (Gas, Light and Coke Company) remarked that the suggestion in the paper

of a prohibition against the use of head-lights in streets implied that public lighting engineers should so arrange matters that the motorist would have no desire to use head-lights, and that surely should be the aim. The trouble, of course, was one of cost. Surely if there was ample money there would be no problem of street lighting. There had been a good deal of discussion on visibility. He was inclined to think that this was becoming a little exaggerated because it concerned one factor only out of those which really controlled the situation from the driver's point of view. The first factor which was outside the ordinary consideration of visibility altogether was the first perception of the obstacle or thing which a driver wanted to avoid which was outside the focus of direct vision. The second factor was the true visibility, and the third, which had not been referred to a great deal, was that the driver should be able to take appropriate action. Personally, he was rather doubtful whether we were planning our streets, especially when there was insufficient money to get more than borderland lighting, taking all these factors into account. To get adequate results with very little money, which after all was the problem, he felt it was necessary first to concentrate on lighting the kerb because as a driver himself he had found the most difficult thing at night was to see the kerb and avoid getting too much to the centre of the road, and possibly contributing to accident. Secondly, it was necessary to avoid the glare, not only direct but indirect, and, finally, to make the conditions generally so that the driver was relieved from fatigue or worry which made him slow in response when he met obstacles of any kind. In particular, attention should be paid to the lighting at junctions and cross-roads, and these matters could be dealt with, in his view, within the funds now available, whereas any endeavour to give complete visibility of everything everywhere over an indefinite length of road might be quite out of the question.

Mr. W. J. ALLBRIGHT, replying to the discussion, said he had only referred to shop lighting and advertising illumination to indicate that the public generally was calling for a higher standard of illumination in all directions. With regard to the use of surge relays, he confessed that the makers of the lamps did not altogether agree with his using them. He had, however, felt that in introducing an entirely new departure there might be certain inherent qualities in the early stages, and perhaps weaknesses, which should be provided against in order to minimise any possible trouble. Moreover, he had adopted the device in order to avoid the new system being held back by the fear that a street or a certain part of a street might be thrown into comparative darkness for as long as five minutes after a slight interruption. Now and then a heavy "short" on a C.E.B. overhead 66 kV line caused a surge on local systems even greatly exceeding the figure of 20 per cent. which had been mentioned, and such a surge might affect a proportion of these lamps. It was for these reasons that he had fitted the surge protective device. No doubt as the lamps improved this need would no longer exist.

On the question of central suspension, he contended that it was one of the strongest arguments in favour of the petrol bus that there were no overhead wires. In any case, he saw no reason why we should add to what already existed in connection with tramway and trolley bus systems. Certainly the beauty of some of the streets on the Continent, with their lines of trees, would be utterly spoilt by any system of centrally suspended lamps. He felt that it was necessary to light the kerbs to a large extent, and that could be done without any overhead suspension, which, in his view, was expensive and ugly.

Although he had heard of the lamp which had been installed at Preston, he could not criticise it from practical knowledge. It was, however, undoubtedly another sign of progress that was being made. He could only hope that these experiments would lead to an even better lamp than now existed.

Undoubtedly Mr. Masterman was right in all he said in regard to the aims of public lighting engineers. At the same time, he felt that the price difficulty was being solved at a much more rapid rate by electrical progress than in any other way. One of the points he had been aiming at, with the aid of his technical advisers and the makers of the lamps, was to get such a lamp that a dog, for example, could be seen at a maximum distance. The greater the distance the better for the motorist. His own view, both as an electrical engineer and a motorist, was that the best method at the present time was to aim at silhouette lighting at a great distance.

As to the effect of introducing gases into the electrical discharge lamp to reduce the colour problem, he believed that cadmium and other gases had been introduced. He understood that in this way the colour had been improved to a very considerable extent, but that there was a loss of efficiency of the order of 25 per cent. His own experience of doing what Mr. Brydges had done was a loss of efficiency and increased cost per lamp unit. Moreover, in making such a change they would be partially losing one of the special characteristics of the new lamp, namely, its power of producing good visibility

A Visit to the Port of London

The final item on the programme of the Association, the visit to the Port of London on September 12, proved to be a most popular event, in which about 400 members, delegates, and friends took part. Besides those who embarked in the s.s. St. Katharine, by invitation of the Port of London Authority, for whom Admiral A. G. Hotham, C.B., C.M.G., a member of the Board, acted as host, accommodation had to be found for an overflow party in the Royal Princess.

Leaving Tower Pier, the party vessels passed down the Pool, viewing the entrances to the London and St. Katharine Docks, the famous Wapping Old Stairs, the romantic headquarters of the Thames Division of the Metropolitan Police, and the site of Execution Dock. Limehouse Reach, with the funnels of Union-Castle liners in the West India Docks, and the Surrey Commercial Docks, with barges piled high with timber were next seen.

Then came Greenwich, where the stately pile of Greenwich Hospital, once a Royal palace and now a Naval College, was much admired. Down Blackwall Reach, where of old the clipper ships lay, past the masts of Captain Scott's "Discovery," in the East India Dock, into Woolwich Reach, and on to the entrance to the King George V. Dock. The "Royal" dock system is formed by three docks (the Royal Victor, Royal Albert, and King George V.) linked together to form the largest sheet of artificial dock water in the world. The locking-in process provided a minor thrill for the party, which then enjoyed a review of some of the finest vessels in the British Mercantile Marine, as well as visitors from overseas.

Few people realise the magnitude of the Port of London, through which flows over one-third of Great Britain's overseas trade, and by which nearly 40 millions of tons of goods are handled annually.

ASSOCIATION OF PUBLIC LIGHTING ENGINEERS

Annual General Meeting

The annual general meeting took place in the Conference Room in the Hotel Metropole at 4 p.m. on the opening day, September 9, an innovation which enabled the new President to be installed in office before the actual conference commenced.

After the minutes of the last meeting had been taken as read THE PRESIDENT announced that Mr. F. X. Algar and Mr. P. Richbell had kindly consented again to act as scrutineers, and the meeting endorsed their appointment.

The Annual Report.

The presentation of the annual report for the past year was as usual undertaken by the HON. EDITOR (Mr. E .J. Stewart), and the HON. TREASURER (Mr. H. C. Brown) made a few remarks in regard to the accounts, which again showed a satisfactory surplus of income over expenditure.

Mr. F. X. ALGAR, in moving the adoption of the report, congratulated the President and officers on their work and the Hon. Editor on the very comprehensive report which he had once more prepared.

The resolution:—

"That the annual report of this association for the year 1934-35 and the accounts for the year 1934 be hereby adopted, and that a cordial vote of thanks be extended to the President, Council, and Officers for their services during the past session"

on being put to the meeting was declared carried unanimously.

A resolution: "That this meeting expresses appreciation of the services of the auditors of this association (Messrs. Cole, Bond and Co., of 90, Cannon-street, London) and approves their re-election for the year 1935-36," was proposed by Mr. S. B. LANGLANDS, seconded by Mr. C. H. WOODWARD, and also declared carried unanimously.

Place of Meeting for 1936.

Mr. ALDERMAN KNIGHT, Chairman of the Eastbourne Conferences Committee, and Mr. J. K. BRYDGES, Borough Electrical Engineer, formally conveyed an invitation for the 1936 conference to be held in that locality.

THE PRESIDENT, in accepting this invitation, mentioned that there were also present representatives from Cheltenham who had a proposal to bring before members. COUNCILLOR E. L. WARD, the Mayor of Cheltenham and Mr. WALTER J. BACHE, Borough Electrical Engineer, then extended an invitation to hold the 1937 conference in Cheltenham. The President, in expressing the thanks of members, said that this suggestion would receive sympathetic consideration in due course.

In response to an invitation to members to bring forward any matters under the title of "Other Business," Mr. T. E. RITCHIE spoke on behalf of the Associates, many of whom felt that they should be represented in some way on the Council of the Association. THE PRESIDENT promised that this suggestion would receive full consideration at the next Council meeting, which would be held very shortly.

Election of Members of Council.

The report of the scrutineers was then handed in. As no new nominations had been put in for Officers, The President, Vice-President, Hon. Secretary, Hon. Treasurer, and Hon. Editor were automatically elected. It was announced that Mr. J. Herbert Clegg (Southport), Mr. C. I. Winstone (London), and Mr. C. H. Woodward (Bournemouth) had been elected Members of Council.

Induction of New President.

Following this announcement, the new President (Mr. A. Maurice Bell) was formally inducted.

The presentation of Certificate and Badge to the retiring President (Mr. Alexander Forbes) was deferred until the opening meeting on the following morning, when those present warmly expressed their appreciation of his services during the past session.

Thanks for Hospitality.

The next item on the agenda was the passing of the following resolution:—

"That a cordial vote of thanks be extended to the Chairman and Directors of the Tottenham and District Gas Company, to the Gas and Electric Supply Industries, and to the Port of London Authority for their hospitality during the Association's visit to London,"

which was proposed by Mr. LENNOX, seconded by Mr. C. I. WINSTONE, and was carried with acclamation.

A supplementary vote of thanks to Mr. W. J. Jones and the E.L.M.A. Lighting Service Bureau for their help in connection with the electric and lighting arrangements in the lecture theatre, and to the General Electric Company, Ltd., for putting their lantern and operator at the service of the Association during the period of the Conference, was proposed by the Hon. Secretary and was also carried with acclamation.

The Lights o' London

One of the most appreciated events during the Conference was the circular tour through nearly twenty miles of London's lighted streets, which took place on the evening of Tuesday, September 10. The series of seventeen coaches which lined up on the Embankment made their trip most expeditiously, and the large party of members, delegates, and friends found the trip a most instructive one.

In the introductory note furnished with the plan of the route it was pointed out that the public lighting of London differs from that of any other city in the world. London is not one city, but an aggregation of communities. There are within its area some thirty-five authorities, all controlling the lighting within their respective areas. The lights on the route inspected are maintained by two great gas undertakings and seven different electrical undertakings. As a result great varieties of method are evident, and practically every modern method of lighting is represented.

The tour, which was arranged with great care, followed a course northwards by way of Regent-street, Oxford-street, Gower-street, and Camden-road; then by way of Pentonville-road, the City-road, and Moorgate into the City of London. From Queen Victoria-street the procession crossed the river at Blackfriars Bridge, traversed Blackfriars-road, Lambeth Palace-road, and the Albert Embankment, crossed the river again and circled round to enter (by special permission) the parks, and traverse Constitution Hill and The Mall.

Doubtless amongst the most striking streets were Grosvenor-road, where the new "Supervia" gas lamps had been installed, and the Albert Embankment and adjacent roads, where electric discharge lamps were in operation. Many other streets, however, were considered excellently lighted; on the other hand there were a few connecting roads (deliberately included in the survey) where the need for improved lighting was manifest.

The President, at the opening meeting, paid a tribute to the great pains taken by Mr. W. J. Jones of the E.L.M.A. Lighting Service Bureau, and Mr. C. I. Winstone, of the Gas Light and Coke Co., in planning this tour, in which gas and electric lighting were approximately evenly represented, and a vote of thanks to them for their efforts was carried with acclamation.

Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from page 269, August, 1935.)

I.—RADIATION AND GENERAL PHYSICS.

249. The Theory of Maximum Visual Efficiency of Coloured Materials.

David L. MacAdam. J. Opt. Soc. Amer., 25, pp. 249-252, August, 1935.

Of all the conceivable spectrophotometric curves of materials exhibiting a given chromaticity when illuminated with light of a specified quality, there must be at least one which yields a maximum value for the visual efficiency. This paper describes the general type of curve which is known to have this unique property. F. J. C. B.

250. Biological Value of U-V. Lamps.

R. Schultze. Das Licht, p. 136, July, 1935.

Three points are dealt with in this article. (1) The biological action of U-V rays; (2) the action of U-V lamps; and (3) the question of a dosage unit. Curves are given showing the relationship between the wavelengths of U-V radiation and its effectiveness in several biological and physiological processes. S. E.

II.—PHOTOMETRY

251. Lamp Polar Curves on the Cathode Ray Oscillograph.

V. J. Tyler and R. H. Brown. J. Sci. Inst., p. 253, August, 1935.

The polar curve of a lamp is depicted visually by means of a system of mirrors rotating round the lamp under test, and a photoelectric cell. The variation of potential difference across a resistance in series with the cell is amplified. The polar co-ordinates thus obtained are converted to Cartesian co-ordinates and applied to the deflecting plates of a cathode ray oscillograph. When the speed of the rotation of the mirror system is sufficiently high, the oscillograph presents to the eye a complete polar curve of the lamp under test. S. E.

252. Visibility Meter for Street Lighting Installations.

C. G. Klein. Das Licht, p. 134, July, 1935.

An instrument is described by the use of which it is claimed that it is possible to assess the following characteristics of a street lighting installation: (a) the effect on visibility of any glare that may be a feature of the installation; (b) the reflection characteristics of the road surface; and (c) the vertical and horizontal components of the illumination. S. E.

253. Nomographic Determination of Vertical and Horizontal Illumination in Street Lighting Installations.

P. Noel and A. Vallat. R.G.E., 38, pp. 11-16, July 6, 1935.

The theory and use of the given nomographs are explained. W. R. S.

254. Visibility of Signals Through Fog.

Gjon Mili. J. Opt. Soc. Amer., 25, pp. 237-240, August, 1935.

The author puts forward the three following steps as a practical solution of the fog-signal problem: (a) The location of signals as close together as is convenient and consistent with installation and operating costs; (b) the design of a signal unit to provide maximum visibility throughout the angle of view by means of lenses or reflectors; (c) the variation of candlepower, depending on weather conditions, by varying the operating voltage of the lamps. F. J. C. B.

256. Interface Reflections between Plane Parallel Surfaces.

F. Benford. Gen. El. Rev., 38, pp. 277-281, June, 1935.

The author describes the effects of multiple interface reflections when, for example, two or more coloured glass filters are placed in parallel position. The order in which the filters are placed is shown to affect the finally transmitted colour. In the case of filters correcting radiation of one colour temperature to that of another, a method of calculating the final result with various filters in various orders is given. G. H. W.

257. Rectifier ("Blocking-Layer") Type Photoelectric Cells and Their Applications.

M. Cohu. R.G.E., 38, pp. 123-127, July 27, 1935.

Contains sections on the history, classification, properties, and interpretation of these properties (e.g., effect of light, spectral sensitivity, effect of temperature, construction) as well as application of these cells. Various diagrams are given. W. R. S.

III.—SOURCES OF LIGHT.

258. The Coiled-coil Lamp for General Lighting.

F. Abshagen. Das Licht, p. 197, September, 1935.

Details are given of the double coil winding of the filament recently adopted for the smaller sizes of electric lamps. The increase in lumen output for 40, 60, 75, and 100-watt lamps is given, and also details of the smaller overall dimensions of these lamps which have been rendered possible by the adoption of the double coiled filament S. E.

IV.—LIGHTING EQUIPMENT.

259. Lanterns for Electric Discharge Lamps.

Anon. El. Times, 88, p. 246, August 22, 1935.

A short description and a photograph of a lantern designed to take 250-watt and 400-watt mercury discharge lamps. W. R. S.

260. Factors in the Design of Opaque Patterns on Luminous Backgrounds.

G. R. La Wall and W. M. Potter. Am. Illum. Eng. Soc., Trans, 30, pp. 385-402, May, 1935.

The paper gives the results of experiments on the clarity of opaque designs on a luminous background and seen at various distances. As test objects horizontal and vertical lines of various thicknesses and a letter E of various sizes and limb thicknesses were used. A decorative pattern was also investigated. The results are given in the form of curves, and the method of use is described. G. H. W.

261. The Transmission of Solar Radiation Through Heat-absorbing Glass.

R. S. Estey and R. A. Miller. Am. Illum. Eng. Soc., Trans., 30, pp. 403-410, May, 1935.

The authors describe the composition and action of a heat-absorbing glass. It is pointed out that the action makes such a glass superior to ordinary glass in the daylight application only when solar radiation falls upon it. Absorption data are given using solar radiation and a tungsten filament lamp with and without a filter converting the radiation approximately to that of the sun. G. H. W.

262. Methods of Measuring Visible and Total Energy Transmission of Heat-Absorbing Glasses.

H. P. Gage. Am. Illum. Eng. Soc., Trans., 30, pp. 411-427, May, 1935.

Spectral transmission measurements are given for a heat-absorbing glass known as AKLO. The difficulties of using solar radiation are discussed and recommendations are made for a standard test procedure using a vacuum tungsten lamp as the source of radiation. A heat-absorbing, colour correcting filter is described. G. H. W.

263. British Standard Specification for Colours of Signal Glasses for Railway Purposes.

No. 623—1935; Brit. Standards Institution, September, 1935.

The specification is concerned with colorimetric and photometric requirements of lenses of various types used on railways. Some such varieties are defined, and a distinction is drawn between moulded semaphore and cut semaphore types. The specification cover measurement of colour and transmittance, tolerances and temperature of test. J. S. D.

264. British Standard Specification for Plano-Convex (Bullseye) Lenses.

No. 624—1935; Brit. Standards Institution, September, 1935.

Such lenses are defined and clauses specifying

diameter and focal distance, thickness of edge or rim of lens, colour, measurement of transmission, and finish are presented. J. S. D.

265. The Reflecting Characteristics of Street Surfaces.
R. C. Weigel and P. Schlüsser. Das Licht, p. 160, July, 1935.

Details of reflection characteristics, together with light intensity and brightness curves for various angles of incidence, are given for typical road surface materials, including asphalt, for bitumen, concrete, and granite. The conclusion is drawn that from the point of view of street lighting a surface of the concrete type is an advantage. S. E.

V.—APPLICATIONS OF LIGHT.

266. The Effect of Lighting on Efficiency in Rough Work (Tile Pressing).
S. Adams. Joint Report of Industrial Health Research Board and Illumination Research Committee, H.M. Stationery Office, August, 1935.

Tables and graphs are presented, showing the percentage increase in efficiency with illuminations from 0.5 to 15 ft.-candles. The inference is drawn that at least 3-4 ft.-candles is desirable, even for "rough" work of this character. J. S. D.

267. Factory Lighting to Fit the Facts.
A. E. Brainerd. Am. Illum. Eng. Soc., Trans., 30, pp. 315-329, April, 1935.

The author describes methods of tackling factory lighting problems which enlist the sympathy of the customer. He recommends attention to the productive plant first, producing good illumination where it is required. This is followed by attention to the lighting generally. Illustrations of the method and suggested report forms are given. G. H. W.

268. Plus Light for Work.
Walter Sturrock. El. World, 105, p. 2,136, August 31, 1935.

Each industrial lighting problem demands individual consideration. The main points to be studied, with special reference to the use of local lighting, are stated, with charts to assist in the correct choice of equipment for any particular type of work. S. S. B.

269. Light and Architecture.
Anon. Am. Illum. Eng. Soc., Trans. 30, pp. 307-314, April, 1935; pp. 377-384, May, 1935; pp. 445-452, June, 1935; pp. 523-530, July, 1935.

Illustrated descriptions of modern interior lighting installations. G. H. W.

270. Modern Lighting in Streamlined Trains and Electric Rail Cars.
R. W. Cost. Am. Illum. Eng. Soc., Trans. 30, pp. 331-350, April, 1935.

The lighting systems in these modern cars are fully described. Indirect lighting is mainly employed. The position of the normal reading plane is defined and illuminations obtained on this plane range from 4 to 15 foot-candles. G. H. W.

271. Lighting Service.
Anon. Elect., 115, pp. 299-300, September 13, 1935; El. Review, 117, p. 340, September 13, 1935.

A description, with photographs, is given of the new lighting equipment installed at the E.L.M.A. lighting service bureau. C. A. M.

272. Advanced Lighting in Auto Showroom.
H. Ketcham and R. Clover. El. World, 105. p. 2,017, August 17, 1935.

A detailed description, with photograph, is given of an installation at the Chrysler showrooms in Detroit, U.S.A. An illumination of 20 f.c. at eye level is provided, using units combining a 1,000 watt tungsten filament lamp with a 450 watt mercury vapour discharge lamp to give a good approximation to daylight. This is increased to 50 f.c. in the windows. S. S. B.

273. An Experiment in Spot Lighting.
R. A. Palmer. El. World, 105, p. 2,046, August 17, 1935.

An interesting result was found in a case of show window lighting, where of three figures the centre one was accentuated by a spotlight. It was found that, although all three figures were well illuminated by the general lighting, the greatest demand was always for the wares demonstrated on the centre figure. The extra lighting on this figure drew more attention to it, and at the same time showed the merchandise to better advantage. S. S. B.

274. Colour Lighting a Blackpool Ballroom.
Anon. El. Review, CXVII., No. 3,015, p. 305, September 6, 1935.

Briefly describes and illustrates an elaborate system of colour lighting of a large ballroom, with remote control of contactors and dimmers. J. M. W.

275. Street-Lighting Notes.
Anon. El. Times, 88, p. 163, August 8, 1935.

A brief account of a street-lighting installation employing sodium vapour discharge lamps, with a photograph. Also a note on the use of standard tungsten-filament lamp street-lighting equipment to assist road repairs. W. R. S.

276. Miniature Road Tests Highway Lighting.
Anon. El. World, 105, p. 2,140, August 31, 1935.

A brief description is given of a model street ($\frac{1}{4}$th scale), 250 feet in length constructed to test visibility with various types of lighting, and with different sources of light. It is stated that preliminary tests show less frequent errors with sodium lamp lighting than with filament lamp lighting. S. S. B.

277. Sodium Lamps for Safety Build Load.
Anon. El. World, pp. 2,144-5, August 31, 1935.

Details are given with a photograph of street lighting installation of rather more than a mile in length of sodium vapour discharge lamp lighting at Geddes, U.S.A. The installation has met with much approval, and will probably be extended. S. S. B.

278. Visibility Under Sodium and Mercury Lamp Light, with Special Reference to Street Lighting.
R. G. Weigel. Das Licht, p. 211, September, 1935.

A report of a lecture given to the I.C.I. at Berlin on July 1, 1935, the general conclusion being that so far as speed of perception and brightness contrast perception is concerned, sodium vapour lamps have an advantage over both mercury and filament lamps. S. E.

279. Sodium Lights to Illuminate San Francisco Bridge.
Anon. El. World, 105, p. 2,024, August 17, 1935.

The new San Francisco-Oakland Bay bridge is to be provided with sodium lighting. It is anticipated that over 900 units will be used on the 15 miles of roadways for the spans, tunnel and approaches of the bridge. S. S. B.

280. The Lighting of Aerodrome Landing Grounds.
O. Höpcke. Das Licht, p. 144, July, 1935; p. 182, August, 1935; p. 202, September, 1935.

In view of the relatively low illumination it is possible to employ commercially for aerodrome landing grounds, it is stated that it is best to use monochromatic or nearly monochromatic light for this purpose. Sodium and mercury vapour lamps are said to be most satisfactory. Mercury lamps have a further advantage in that their light is very effectively reflected by grass, thus giving the appearance of high illumination. The required type of light distribution for the satisfactory lighting of landing grounds is discussed, and is followed by a description of the various types of lamps and equipment used for this purpose. S. E.

281. The Lighting of Sports Grounds.
B. Schmelzle. Das Licht, p. 140, July, 1935.

Details are given of lighting installations on football fields and ice hockey rinks. These details include the arrangement of the units, and their mounting, the type of units and watts used, the running cost, and the lighting intensities obtained. Particular attention is directed to the minimising of glare; cut off angles of 30 deg. below the horizontal being generally used. S. E.

282. Floodlighting.
Anon. Elect., 115, p. 246, August 30, 1935.

A brief description is given of a floodlighting unit consisting of a large trough reflector fitted with a row of nine 1000w. projector lamps. C. A. M.

283. Chester Illuminations.
Anon. Elect. 115, p. 273, September 6, 1935; p. 323, September 13, 1935.

Numerous photographs are given showing results produced by various floodlighting installations at Chester. C. A. M.

284. Recent Advances in the Use of Light for Plant Growth.
L. C. Porter. Gen. El. Rev., 38, pp. 268-271, June, 1935.

The article describes a heat-insulated greenhouse with only a single row of windows in which artificial lighting is provided by 300-watt lamps in R.L.M. reflectors. Some test results are given, and there is a general discussion on the use of various wave-lengths for plant growing. G. H. W.

Recent Patents

(Abstracts of recent Patents on Illumination & Photometry.)

No. 431,298. "Improvements in Luminous Electric Discharge Tubes."

Forrester, H. J. C. (Communicated by Luminous Tube Lighting Corporation), July 20, 1934.

In order to increase the capacity between the gas filling and electrodes of discharge tubes with external electrodes and so to obtain a reasonable current flow at low frequencies, a substantial number of tubes, each of smaller diameter than the main tube and in communication therewith, are individually enclosed in recesses within each external electrode. These small tubes may be arranged in groups or rows, and may be coated externally with conducting material.

No. 431,321. "Improved Lighting or Like Devices Comprising at least two Gasfilled Electric Discharge Tubes."

N. V. Philips Gloeilampenfabrieken, February 8, 1934 (Convention, Germany).

This specification relates to the production of a light source of high brilliancy by means of discharge tubes. An optical device, such as a lens, is arranged between two tubes to produce at tne discharge path of the first tube an image of the discharge of the second tube. A reflector may also produce at the discharge path of the second tube a real image of the discharge of that tube

No. 431,810. "Improvements in Electric Discharge Lamps."

Siemens Electric Lamps and Supplies, Limited, Oakley, P. D., and Aldington, J. M., May 31, 1934.

This case relates to discharge lamps, particularly of the high-pressure type, incorporating a core of emissive material embraced by a heating helix to form the cathode. Tantalum wire is used for the heating helix to reduce the blackening of the lamp envelope. Also the diameter of the wire forming the helix is increased beyond that usual to produce a lower operating temperature during the inactive half cycle, when the electrode is serving as anode, on alternating supply.

No. 431,885. "Improvements in or Relating to Lamp Fittings and Reflectors."

Engineering and Lighting Equipment Co., Limited, Wells, G. J., March 14, 1934.

This specification covers a lantern, intended particularly for street, etc., lighting with a vertical elongated light source, containing in the upper portion of the lantern two or more reflectors pivoted both horizontally and vertically for adjustment, and near the lower part of the source two or more reflecting or diffusing plates mounted independently of each other and capable of adjustment in any direction.

No. 431,953. "Photographer's Flash Lamp."

Doering, W. W., May 3, 1933. (Convention Germany.)

This specification describes a flush bulb of the type containing inflammable material such as foil, and an active atmosphere such as oxygen, in which the inflammable material may be ignited by external mechanical action. A percussion cap forms part of the envelope wall, and an impact applied thereto causes ignition of the combustible material.

No. 432,145. "Improvements in or Relating to Lamp Screens, Shades, and Reflectors."

Degea Aktiengesellschaft (Auergesellschaft), June 8, 1933. (Convention, Germany.)

For obtaining a better colour effect it is known to employ glass containing neodymium oxide, but this involves certain disadvantages, which are overcome, according to this specification, by utilising for screens, shades, and reflectors a transparent or translucent material, such as translucent paper or cellulose acetate, containing a neodymium compound such as neodymium ammonium nitrate.

No. 432,296. "Improvements in or Relating to Burners for Incandescent Gas Lamps or Lanterns."

Naamlooze Vennootschap Machineneen-en-Apparaten Fabrieken "Meaf," December 19, 1933. (Convention, Germany.)

According to this specification, the gas flowing to a burner flows through a constriction, after which it is mixed with air, and the mixture flows through another constriction, and finally issues through openings to the mantle. The openings are of such size in relation to the second constriction that their throttling effect, together with that of the mantle, is substantially equal to that of the second constriction, so that upon breakage of the mantle the mixture tends to flow through the openings faster than it can flow through the second constriction, and the flame is therefore extinguished.

No. 432,320. "Improvements in Luminous Electric Discharge Devices."

The General Electric Company, Limited, June 29, 1934; March 4, 1935. (Cognate Applications Communicated from Germany.)

According to this specification, all the electrodes of a luminous tube, for emitting light approximating more closely to daylight than that of a caesium or rubidium lamp, are of tellurium, and the envelope is of transparent material, such as quartz, which will withstand attack by tellurium and its vapour.

No. 432,722. "Improvements in Electric Arc Lamps and the Like."

Miles, F. D., and Jones, G. G., and Imperial Chemical Industries, Limited.

This specification relates to discharge tubes filled order to avoid accumulation of deposits on the inner surface of the transparent shield a continuous film of aqueous or other liquid is passed over it.

No. 432,750. "Improvements in or Relating to Incandescent Gas Mantles."

South Metropolitan Gas Company, Chandler, D., and Prestage A. J., April 21, 1934.

According to this specification a gas mantle comprises a main metal wire with a second metal wire wound helically or spirally around it and itself wound helically or spirally. Stainless steel or a nickel-iron-chromium alloy is suggested for the wire. The mantles are said to be serviceable for gas fires and for medical lamps.

Special Gas Lighting

We understand that the electric lighting in the streets of London seen on the occasion of the A.P.L.E. tour, described on page 339, was of a normal character, though in one or two instances efforts were made to get projected installation completed before the Conference opened. In the case of the gas-lighted streets, however, a considerable amount of work was put in by certain firms for the occasion, and it is fitting that some recognition should be given to their efforts. The chief instance of special work was doubtless Blackfriars-road, where the new "Supervia" lamps were in evidence. Messrs. Jas. Keith and Blackman were also responsible for many of the high-pressure lamps in use, for example in Regent-street, New Oxford-street, and in the City of London. On Grosvenor-road and Westminster Bridge-road, and elsewhere Messrs. W. Sugg and Company's lamps with Holophane Refractor Dishes were used, a feature in Sloane-street being the adoption therewith of "daylight" mantles supplied by Lighting Trades, Ltd. Messrs. C. H. Kempton and Co., Ltd., furnished lamps for the Chelsea Embankment, the King's-road, Chelsea, and elsewhere. "Kemborn" and "Parkinson" lamps (the latter with "Morlite" reflectors) were in use in Gower-street. Steel tubes, for supporting, raising, and lowering gear, etc., were supplied by the Bromford Tube Company, and the British Mannesman Tube Company.

Finally, mention should be made of the control equipment of the Gas Meter Company, and the Horstman Gear Co., Ltd., used to operate various installations.

During the period of the Conference of the Association of Public Lighting Engineers, arrangements were made to floodlight several public buildings, which had figured during the Jubilee celebrations, namely The Horse-guards, "Big Ben," the National Gallery, the County Hall on the Embankment, and St. Paul's Cathedral.

We are indebted to Messrs. Siemens Electric Lamps and Supplies Ltd., for the above striking picture of "Big Ben," which was taken from Palace Yard.

The British Standard Specification for Portable Photometers, Visual Type, B.S.S. No. 230-1935.

The revision of the above British Standard B.S.S. No. 230-1935 has just been carried out at the request of the Street Lighting Committee of this Institution, who required a Photometer with a greater degree of accuracy than that provided for in the original issue of this Specification.

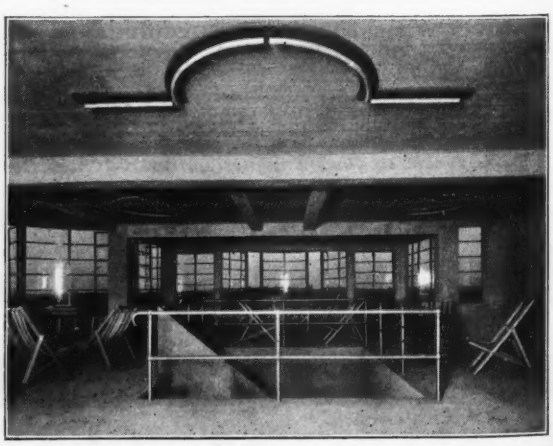
The limits of error in the indications have therefore been reduced from 15% to 10%. The effective range of the Photometer has also been modified and several other small changes of importance have been made in the revised Specification, including the addition of an Appendix in regard to measurement involving large colour differences.

Copies of this revised British Standard Specification No. 230-1935, which is of special interest to engineers concerned with public lighting, may be obtained from the Publication Department, British Standards Institution, 28, Victoria Street, London, S.W.1, price 2/2 post free.

For quantity orders special reduced rates are quoted, and for orders of 100 copies and over names and addresses will be overprinted on each cover in red without additional charge.

A Club with Modern Lighting

The lighting of the Seaborne Club, Dymchurch, which was planned jointly by Mr. L. J. Ive, electrical contractor (of Dymchurch and Watford), and Messrs. Young and Wildsmith (of London), is believed to be the first building in this country lighted entirely by



The Sun Lounge, Seaborne Club, lighted solely by quarter circle and straight lengths of Mazda Light Tubes.

architectural lamps. 320 feet of Mazda Light Tubes are used, and this is the only form of lamp adopted. The lamps conform with the general tubular trend of the furniture, stair railings, etc., and the amber glow is specially effective in association with the light woodwork.

Fenchurch Street Station

New Lighting Equipment

London's second oldest railway station—Fenchurch Street—has been largely reconstructed, equipped with Electric Signalling and generally brought up to date to meet present day traffic requirements.

Amongst the improvements completed is the new Electric Lighting Installation. Electric Discharge Lamps and fittings have been adopted, and the accompanying picture suggests that the light has been effectively distributed.

The installation under the main roof consists of eight "Sieray" electric discharge lighting units mounted at a height of approximately 20 ft. above platform level. Each unit comprises a lantern containing one 250-watt "Sieray" lamp (type "H") and three 75-watt tungsten filament lamps, the latter being arranged at 120° intervals around the discharge lamp. Over the platforms the lanterns are spaced 66 ft. apart with an interval of 40 ft. between the two lines of lanterns.

Owing to the intervention of the line of local ticket barrier lights the two lanterns outside the ticket barrier are 77 ft. from the nearest platform lanterns, and are 52 ft. apart.

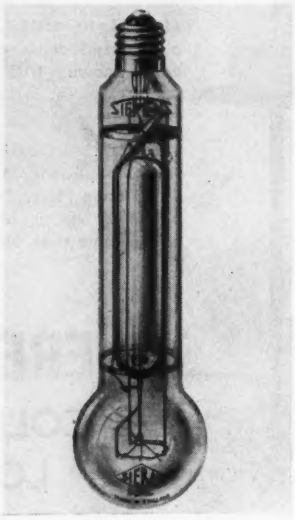
The area lighted is approximately 290 ft. long by 104 ft. wide at platform level, and the height to the bottom of the roof trusses is approximately 40 ft. The total lighting load under the new system is 5.2 kw., which includes sundry points for local lighting at the barriers, etc.

The illumination under the new scheme is greatly superior to that obtained under the old system using tungsten lamps only, and the whole station has a cheerful aspect. Most of us could probably recall some other railway stations which are—to put it mildly—not very cheerful places, and which would benefit by better lighting.

A New Electric Discharge Lamp

A new type of electric discharge lamp has been developed in the Siemens Laboratory at Preston, which embodies two fundamental improvements as compared with existing discharge lamps. Firstly, that choke coils and condensers are entirely eliminated, and secondly, that the light emitted is of a pleasing colour.

This lamp will be marketed under the trade name of "Sieray-Dual" and comprises a "Sieray" discharge lamp, together with a tungsten filament, which is used to control the current in the discharge portion of the lamp, the normal tubular outer bulb of the "Sieray" discharge tube being expanded at its lower end to accommodate the filament so that the electric discharge lamp and its control are thus incorporated in a single unit. The tungsten filament operates at its normal efficiency and fills the dual functions of controlling the discharge and also emitting light in which is present a considerable measure of red rays which implement the greenish blue light from the discharge tube so that the resultant light from the lamp is of a pleasing colour.



As no choke is used in the circuit it follows that the condenser used in the ordinary electric discharge lamp circuits for power factor correction is also unnecessary. Accordingly no alterations to existing wiring are necessary, and the lamps can be screwed into normal Goliath holders and operate direct from the A.C. supply mains.

We understand that this new lamp, which was marketed on September 2, will be on view at the opening meeting of the Illuminating Engineering Society on October 8.

Lighting in New Chigwell U.D.C. Council Offices

The installation illustrated below is typical of many now being adopted in new buildings. The recently opened Chigwell U.D.C. Council Offices have evidently been fitted up on quite modern lines, with overhead lighting in the council room and floodlighting (from a single unit!) for the exterior.

The new Chigwell U.D.C. Chamber which contains six panels built flush with the ceiling. Each panel is equipped with four Holophane Hedralite Plates, above which are four 75 watt lamps furnished with focussing type prismatic reflectors.

Contracts Closed

EDISON SWAN ELECTRIC CO., LTD.

Southern Railway Company.—For the supply of their requirements of electric lamps during the twelve months from September 1, 1935.

SIEMENS ELECTRIC LAMPS AND SUPPLIES, LTD.

Southern Railway.—For the supply of Siemens electric lamps for the ensuing twelve months.

The exterior of the offices which is illuminated by a single Holophane H.F.1,000 floodlight. The illustration shows the wide spread of this unit.

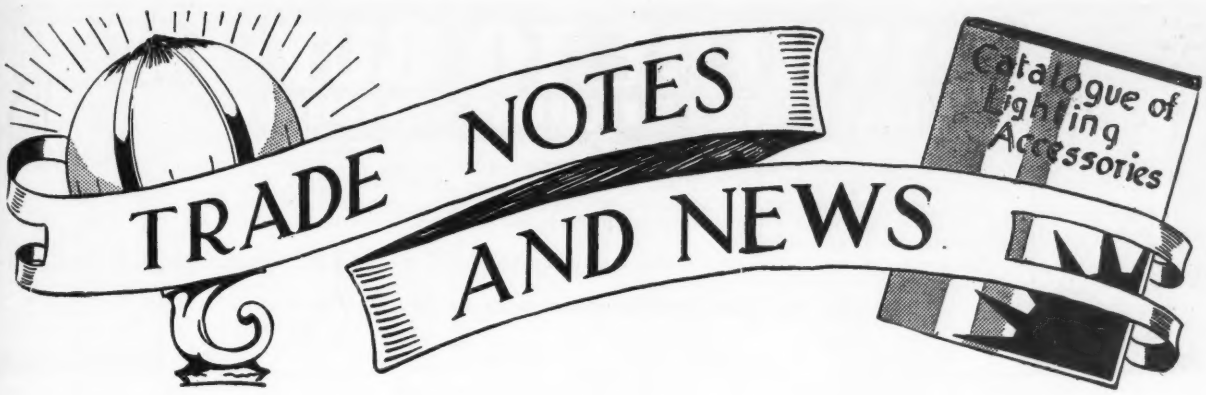
Shipping, Engineering & Machinery Exhibition.

Annual Visit to on September 24.

The usual annual visit to the above exhibition, in which the Illuminating Engineering Society and the Association of Public Lighting Engineers participate, took place on September 24, and once again proved a popular event. At the luncheon given to the councils of the bodies concerned Mr. A. H. W. Beuttell, President-Elect of the Illuminating Engineering Society, was amongst those who conveyed thanks. Although lighting did not figure very largely amongst the exhibits, the display was of considerable general interest. One noticed quite a number of good examples on the various stalls. Perhaps one of the best was the display of industrial gas lighting units and the floodlighting of wall-placards in the background in the display of the British Gas Federation. Ingenious adjustable local lighting units were on view at the stall of Mek-Elek Engineering, Ltd., and the display of G.V.D. Illuminators, Ltd., with its internally illuminated diffusing glass pillars was distinctive. Another exhibit in which light was concerned was the demonstration by Sinterae, Ltd., of their vibratory light system. This is said to have been tried for beacons with good results, at Tilbury and elsewhere.

E.A.W. Winter Programmes.

Three Winter programmes have been arranged by the Electrical Association for Women, the London Branch Programme, the Demonstrators' Circle Programme, and the Teachers' Circle Programme. The first-named includes what is surely an intriguing item—a debate on the topic "Women should spend more on Electricity and their Electrical Equipment than Dress!" Mr. J. W. Townley, Engineer and manager of the West Ham Electricity Department is the bold opener of this debate. We notice also a lecture by Mr. E. Vane on "The Problems of the Builder in the All-Electric Home."



An Imposing Catalogue

The new G.E.C. catalogue of "Installation Material," of which, we understand, no fewer than 40,000 have been printed and put into circulation, is an imposing production containing nearly 1,000 pages. As the new title implies, the range of the catalogue has been diminished somewhat, certain sections, such as those falling under "heavy engineering," being now omitted. The catalogue gains in compactness as a result. The get-up of the book, which must have involved an immense amount of work, is excellent. We like particularly the ingenious index system, the key to which is given on the two central pages of the volume.

Farnborough Street Lighting

A new system of street lighting has just been installed at Farnborough to the requirements of Mr. I. C. Jenkins, B.Sc., A.M.I.C.E., Engineer and Surveyor to Farnborough U.D.C. The Supply Authority is the Mid-Southern Utility Co., for whom Mr. A. V. Barraclough is Chief Engineer.

The installation consists of 144 250-watt Osira electric discharge lamps housed in G.E.C. Lewisham lanterns. They are mounted 25 ft. above the roadway on 5 ft. projection arms abutting from the columns. The spacing is variable and averages from 150 to 200 feet between columns, each of which is fitted with a Venner time switch. The whole of the steel posts, lamps, and controlling equipment were supplied by the General Electric Company, Ltd.

The excellent photograph before us suggests that even brightness over the roadway has been very successfully attained, notwithstanding the fact that on one side of the roadway there are trees and open country, so that little aid in the form of reflected light can be expected.

Hailware Shades

With the opening of the new Lighting Season there are good opportunities for novelties in lighting equipment. The Hailware three-ply shades illustrated above are designed to combine efficiency with pleasing appearance, and they are entirely British made.

E.L.M.A. 32nd Illumination Design Course

We have before us particulars of the 32nd Illumination Design Course, to commence on October 14, in the redecorated lecture room of the E.L.M.A. Lighting Service Bureau (2, Savoy-hill, London, W.C.2). There are six lectures, on attractive subjects, arranged for successive Mondays. We do not doubt that the course will prove as popular as its thirty odd predecessors, and we advise those interested to get in touch with the Bureau without delay.

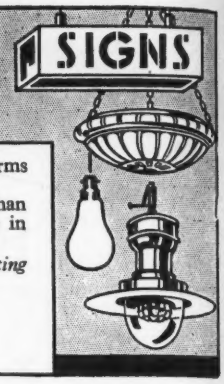
Linolite Equipment

Some excellent seasonal literature has been prepared by Linolite Ltd. Within a folder of modern design (with the slogan "Something To Get Busy On"), is a leaflet illustrating the numerous special devices which the firm has to offer. Besides the familiar Linolite lamps and sections, we observe a new Linolite architectural strip, featuring tubular lamps, desk and pulpit lights, picture lighting reflectors, shelf signs, etc. Of special interest is the application of the ingenious "K-Ray" device, originally applied to picture lighting, to double-sided swinging signs.

Cryselco Lamps

We referred recently to some attractive showcards, etc., produced by Cryselco Ltd. The catalogue before us also bears evidence of skilful design. The firm is of old standing—"the first Cryselco lamp was made in 1895," but the list before us is entirely modern, with details and prices of lamps for all purposes. The two central pages are occupied by a display, in colour, of colour sprayed, natural coloured glass, and daylight blue lamps.

·WHERE TO BUY·
A DIRECTORY OF LIGHTING EQUIPMENT



We invite applications for spaces in this new section of the journal. Particulars of terms for each space (approx. 1 inch deep and 3½ inches wide) are given below.

These terms are equivalent to **half our ordinary advertising rates,** but not less than 12 successive monthly insertions can be accepted on this basis, and amounts are payable in advance.

Payment for an advertisement in this section entitles the advertiser to receive *The Illuminating Engineer* during the period of the contract.

Terms:	**12**	**Successive Monthly Insertions**	**£3 10 0**	**Payable**
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New Catalogue on application

Fittings manufactured to Architects' Specifications

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for testing candle-power and illumination. Benches, Cubes, Heads, Standards of Light, Special Fittings and Accessories.

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Decorative Fittings in Glass and Metal.

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BENJAMIN

PLANNED LIGHTING

You get the benefit of over twenty years' experience in the science of Commercial & Industrial Illumination when you specify Benjamin.

THE BENJAMIN ELECTRIC, Ltd., TARIFF ROAD, N.17

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BROMFORD

Seamless Steel Lighting Standards

for all requirements

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Sole Proprietors and Patentees of the **"ALL PURPOSES"**

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BI-MULTI AND MULTIPLANE REFLECTORS

Lanterns, Brackets, Columns, Switch and Fuse Boxes, etc., FOR STREET LIGHTING

The Electric Street Lighting Apparatus Co.

The Foundry, Canterbury

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Suspension Lamps, Lanterns, **REFLECTORS** for **PUBLIC & INDUSTRIAL LIGHTING**

GAS and ELECTRIC

VITREOUS ENAMELLING Sheet Metal Work, Metal Spinning, &c.

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For Domestic and Artistic Lighting Fittings

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All kinds of Lamps, Reflectors, etc., Tested

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FINRAY THE NEW LIGHTING

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Index to "Where to Buy"

N.B.—The numbers are those attached to individual entries in the Directory (See pp. 352-354.)

The Electrical Accessories Association.

A body under the above name has recently been formed to promote, develop and safeguard the interests of manufacturers, distributors and users of electrical accessories. Its policy is based on co-operative principles and its management is vested in a representative Council of which Mr. H. M. Harris is Chairman. Further information may be obtained from the Secretary at 36, Kingsway, London, W.C.2.

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